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STATE OF MONTANA
TELECOMMUNICATIONS NETWORK
PROJECT FEASIBILITY ANALYSIS
REPORT AND RECOMMENDATIONS

VOLUME 2

APPENDICES

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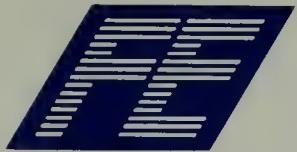
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APPENDICES

March 1986

Prepared for the Telecommunications Bureau
Information Services Division
Department of Administration
State of Montana

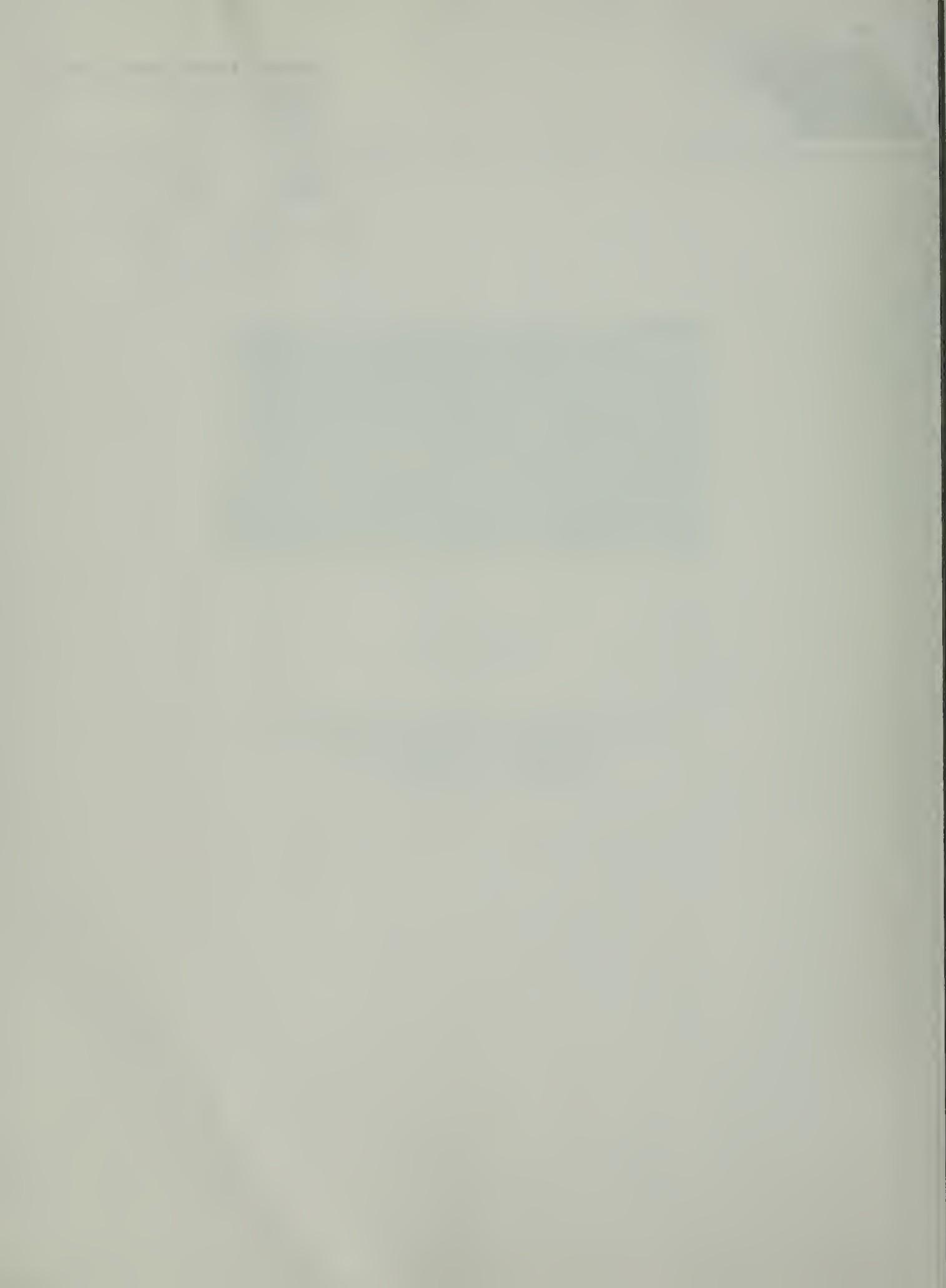
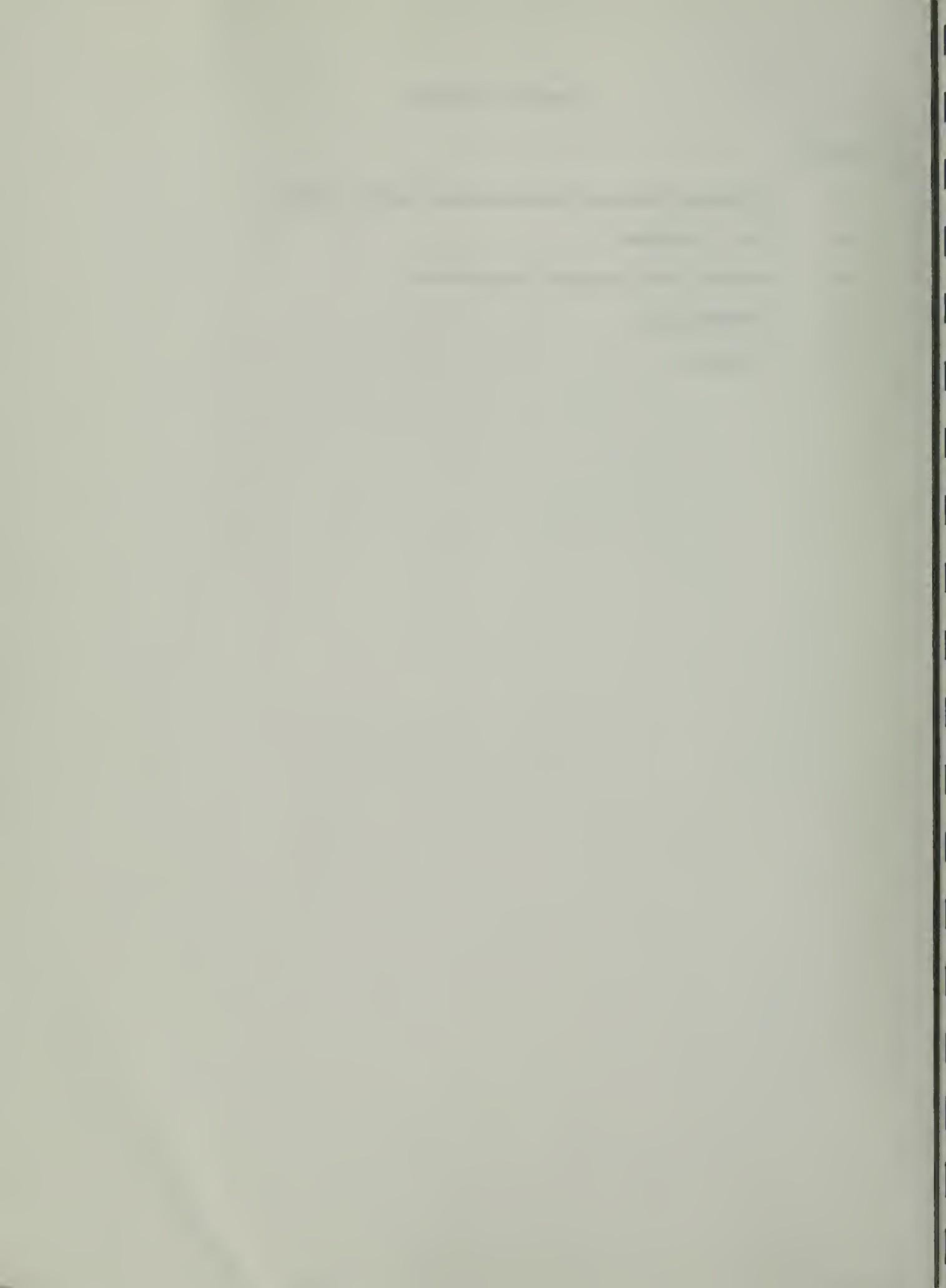


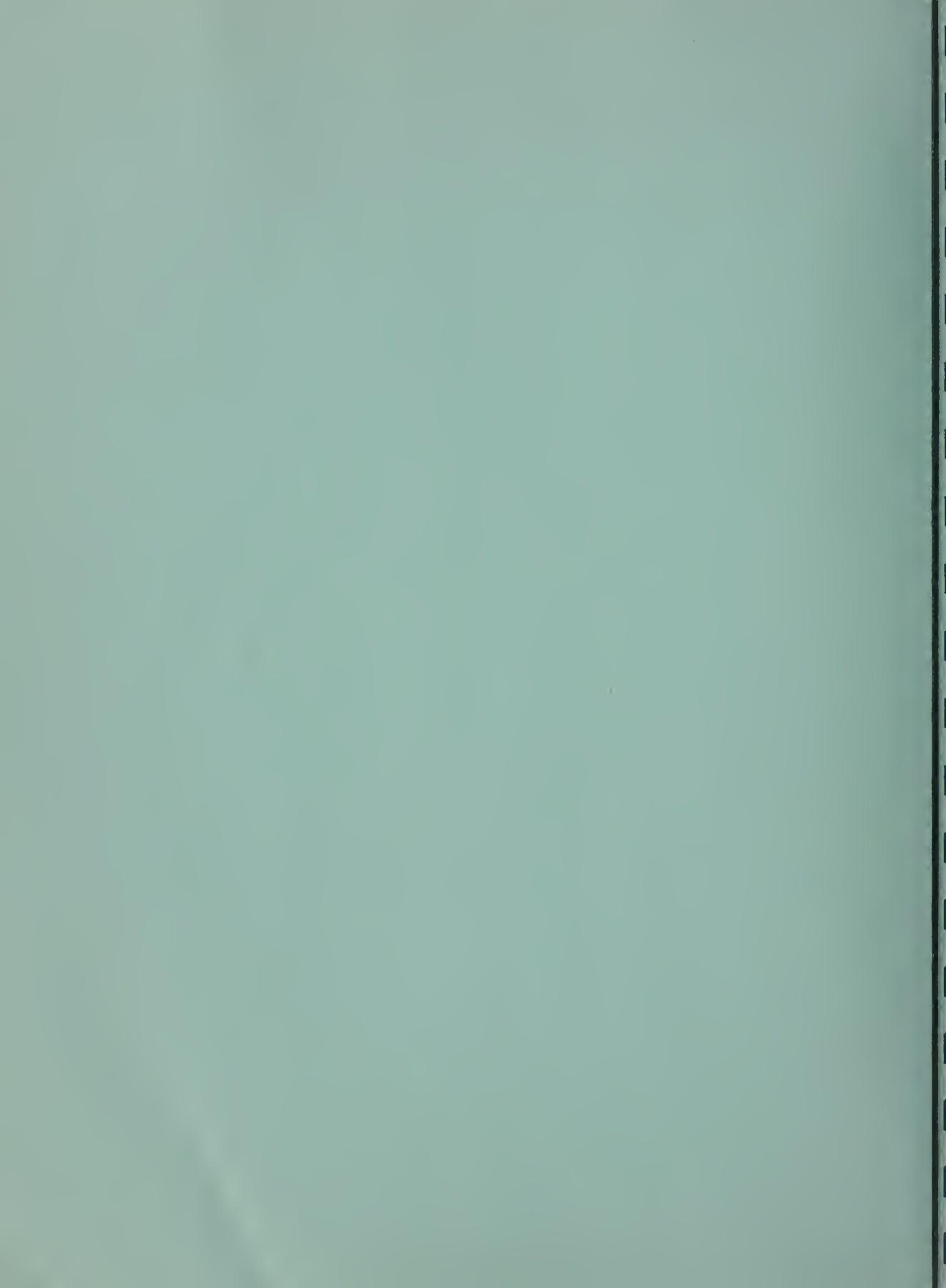
TABLE OF CONTENTS

Appendix

- A Telecommunications Policy Advisory Council (TPAC)
- B User Interviews
- C Present Worth Economic Calculations
- D Bibliography
- E Glossary

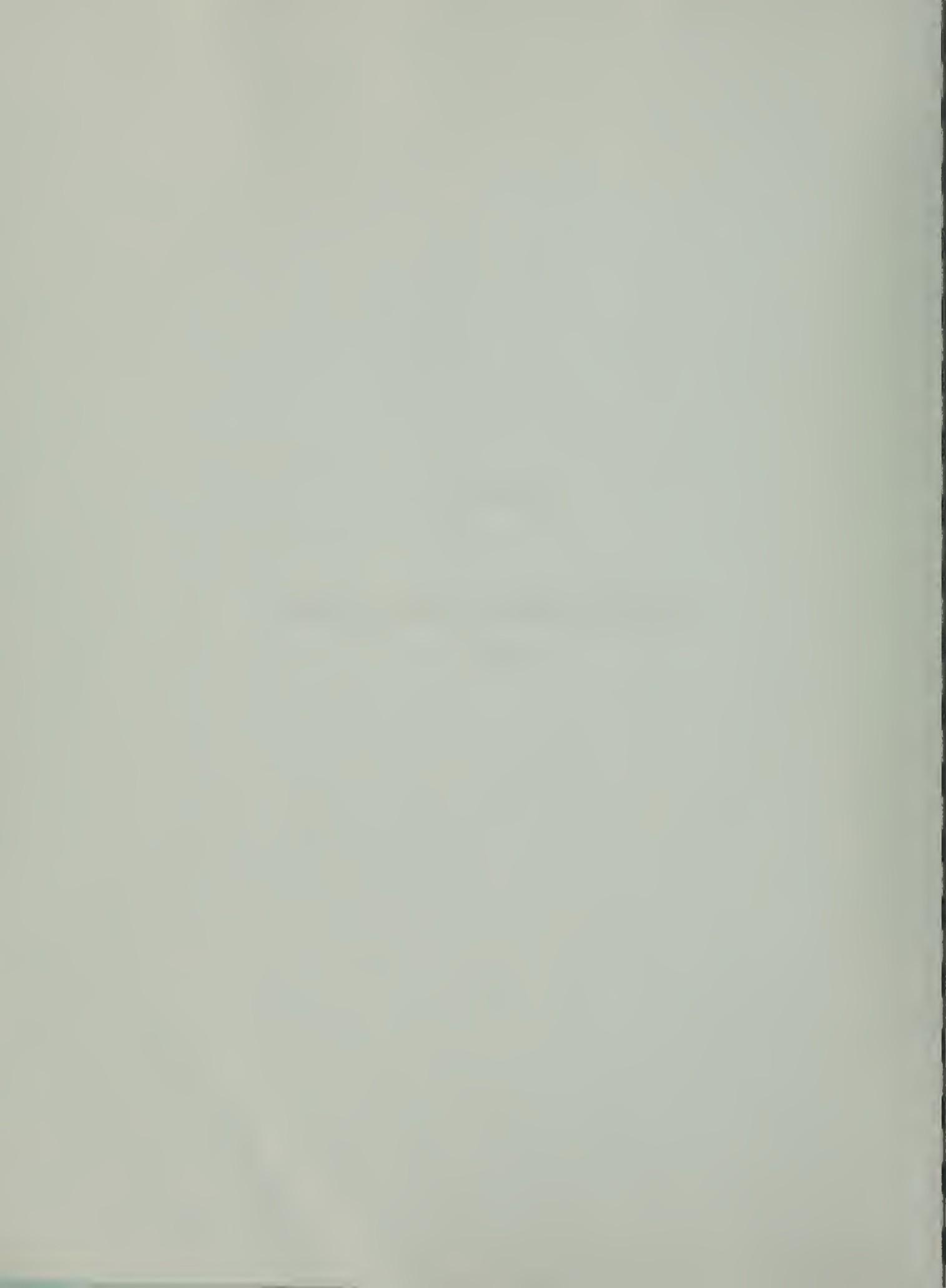






APPENDIX A

**TELECOMMUNICATION POLICY ADVISORY COUNCIL
(TPAC)**



TELECOMMUNICATIONS POLICY ADVISORY COUNCIL
Member List

Rep. Joe Quilici
Chairman
3040 Kossuth
Butte, MT 59701

Sen. Dick Manning
Vice Chairman
810 Seventh Ave. No.
Great Falls, MT 59401

Sen. George McCallum
Box 262
Plains, MT 59859

Dave Wanzenried, Commissioner
Department of Labor & Industry
Helena, MT 59620

Gen. James W. Duffy
Dept. of Military Affairs
1100 N. Last Chance Gulch
Helena, MT 59620

Rep. Earl Lory
4795 Miller Creek Rd.
Missoula, MT 59803

Ardith Aiken, Commissioner
Great Falls City Commission
P.O. Box 5021
Great Falls, MT 59403

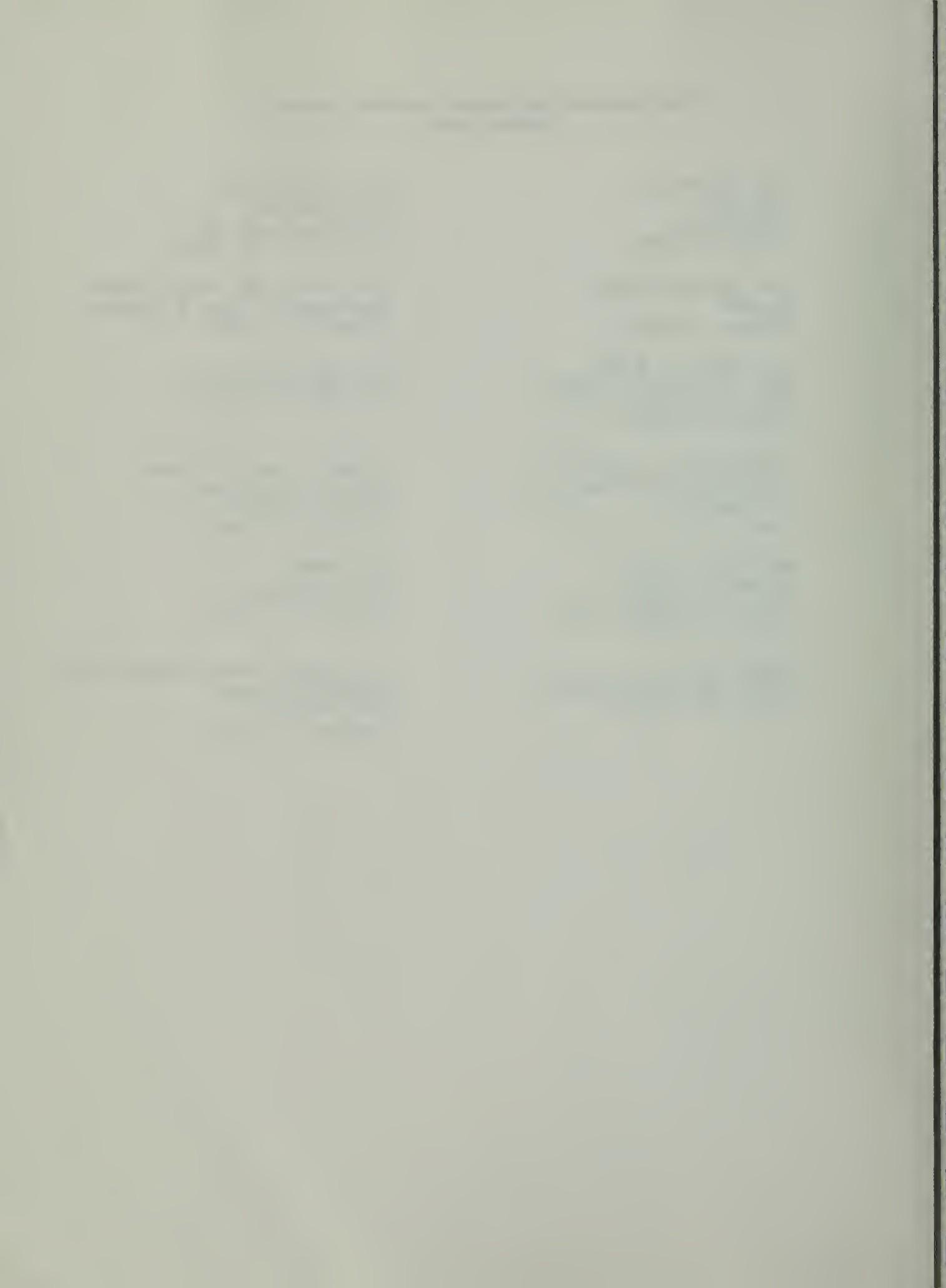
Gordon Browder, Chairman
Board of Crime Control
2309 Cloverdale
Missoula, MT 59801

William J. Lannan
University System
33 S. Last Chance Gulch
Helena, MT 59601

Sara Parker
State Librarian
Helena, MT 59620

Daniel Dolan
Office of Public Instruct.
Helena, MT 59620

Lyle Stortz, County Commissioner
Musselshell County
P.O. Box 686
Roundup, MT 59702

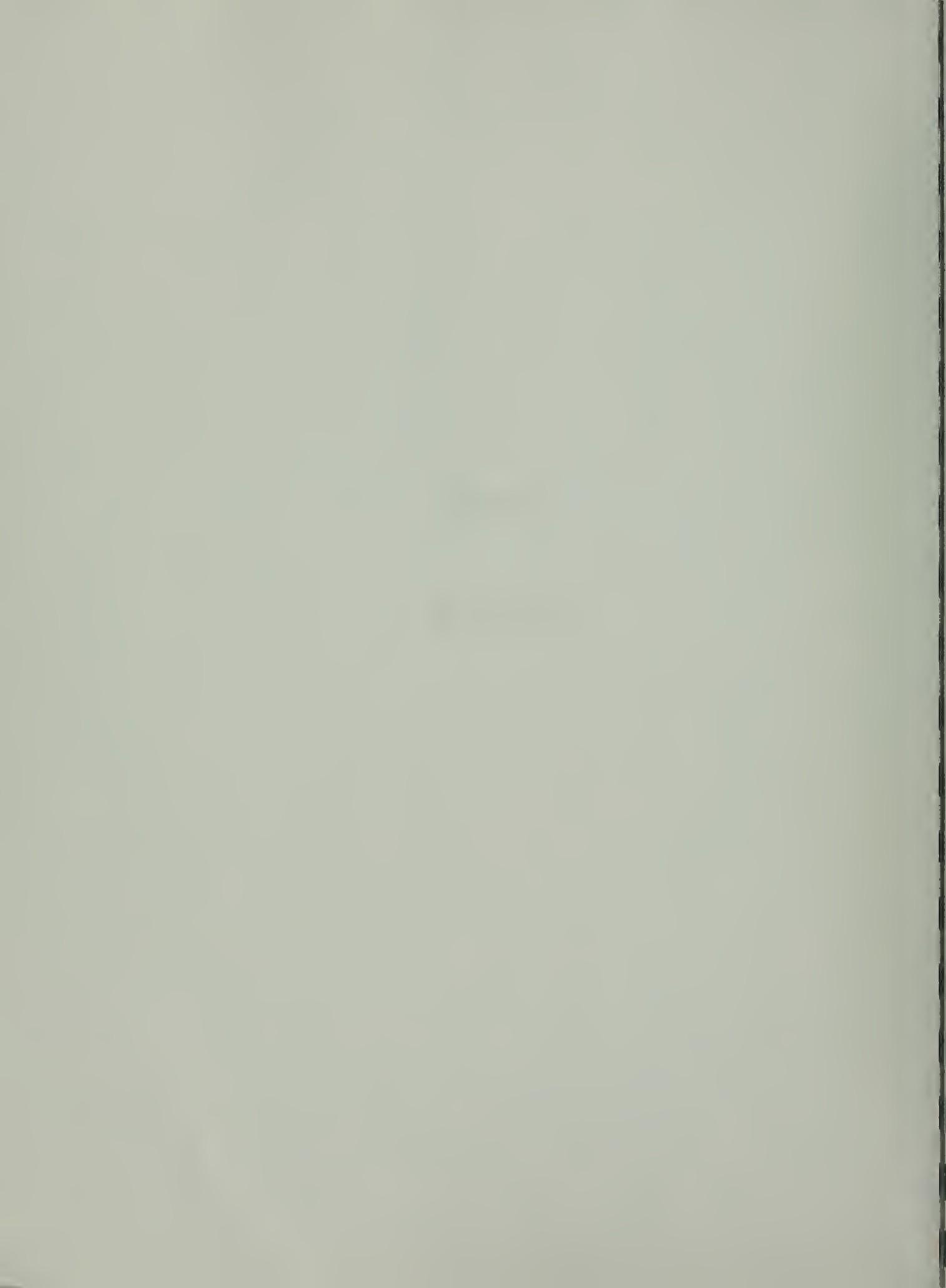






APPENDIX B

USER INTERVIEWS



INTERVIEW RECORD

Person Interviewed:

Date:

Organization:

Number of Employees in Organization:

Type of Service: Voice Data Other

Is present service adequate for needs of organization?

Are there any expected changes in the organization?

Change in size in percentage:

More or less centralization:

Change in technical requirements:

 Data

 Video

 Facsimile

 Mobile Radio

 Remote Sensing

 Roadside Emergency Phones

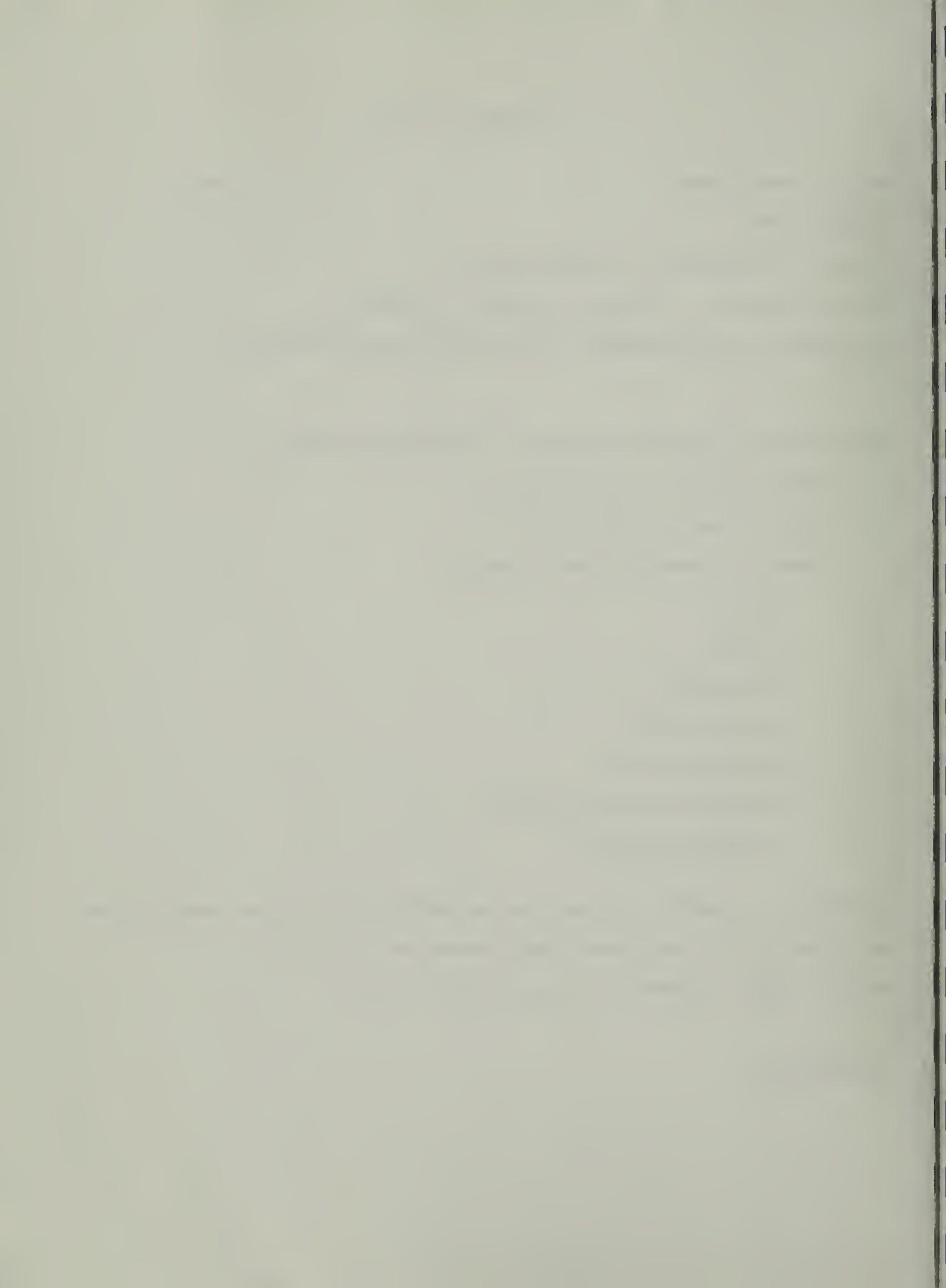
 Highway Telemetry

Is there a disaster recovery responsibility within the organization?

Has organization used the teleconferencing facility?

Would a video conferencing capability be used?

Interviewer:



AGENCIES INTERVIEWED

Department of Administration
Department of Agriculture
Montana Arts Council
State Auditor's Office
Office of Budget and Program Planning
Department of Commerce
Department of Fish, Wildlife and Parks
Governor's Office
Department of Health and Environmental Sciences
Department of Highways
Montana Historical Society
Department of Institutions
Department of Justice
Department of Labor and Industry
Department of State Lands
Legislative Council
Legislative Fiscal Analyst
State Library
Department of Livestock
Department of Military Affairs
Department of Natural Resources and Conservation
Office of Public Instruction
Public Service Commission
Department of Revenue
Secretary of State
Department of Social and Rehabilitation Services

Supreme Court

Montana University System

Eastern Montana College

Montana College of Mineral Science and Technology, Butte
Earthquake Studies Office, Montana Bureau of Mines
and Geology

Montana State University

University of Montana

Northern Montana College

Miles Community College

DEPARTMENT OF ADMINISTRATION

VOICE

-Voice service is meeting needs

DATA

-Activities of divisions of the Department of Administration are vital to the work of other State agencies. All are interdependent with, e.g.,

- Purchasing
- Architecture and Engineering
- Treasury
- Information Services
- Publications and Graphics

-Interested in machine readable and electronically indexed

- Administrative Rules of Montana
- Personnel policies
- Operations manual

-Electronic mail and calendaring can improve communications, reduce use of paper and photocopy

Interviewed: Ellen Feaver, Director
Dave Ashley, Deputy Director

DEPARTMENT OF AGRICULTURE

VOICE

- Voice service is meeting needs
- Teleconferencing supports some Board meetings

DATA

- Eight personal computers in the Scott Hart Building share access to a disk memory
- Personal computers are being installed in the district offices; hope to add communications capabilities
- The U. S. Department of Agriculture is encouraging the use of electronic mail in communication with their offices
- Access on-line databases, e.g., a pesticide database at Purdue University in Indiana

98 employees, plus 20 additional in summer

Interviewed: Ralph Peck, Deputy Director

MONTANA ARTS COUNCIL

VOICE

-Voice service is meeting needs

DATA

-Linked into 10-state ARTSNET, supported by the Western States Arts Foundation, based in Santa Fe

-Seeking ways that communications technology can help in linking Montana's high proportion of artists with one another, and with their markets.

-Building coalitions of arts organizations

Interviewed: David Nelson, Director
Bill Pratt, Organizational Services Director

STATE AUDITOR'S OFFICE

VOICE

-Voice service is meeting needs

DATA

-The office is responsible for

- Payroll and Warrant writing
- Insurance activities within Montana
- Securities activity within Montana

-An office automation project is now underway

-Payroll now operates as a batch processing system in the main-frame; working toward direct on-line terminal processing by the agencies instead of current paper forms for input.

-In insurance and securities, working toward electronic on-line report filing -- both by companies to State, and State to national databases

Interviewed: Dick Gilbert, Deputy Auditor
Richard Hall

OFFICE OF BUDGET AND PROGRAM PLANNING

VOICE

-Voice service is meeting needs

DATA

-As other departments and agencies carry forward their automation projects, OBPP may have easier and more direct access to information

-Dependent to a large degree on efforts other agencies make in getting budget planning information into machine-readable form

Interviewed: Dave Hunter, Director
 Doug Booker, Budget Office

DEPARTMENT OF COMMERCE

VOICE

- Voice service is meeting needs

DATA

- Currently have direct terminal access to mainframe
- Investigating a minicomputer system to support a departmental management system
- Local government relations responsibilities include:
 - Pass-through grants
 - Auditing functions
 - Technical assistance
 - Housing programs
- Some local government would like to provide report data on-line, and this is a direction for the future
- Lieutenant Governor Turman directed a project to support better information exchange between local governments and state government

260 employees in Helena

Interviewed: Keith Colbo, Director
Andy Poole
Alene Gorecki

DEPARTMENT OF FISH, WILDLIFE AND PARKS

VOICE

-Voice service is meeting needs

DATA

-Developing a plan to provide data links from seven regional offices with Helena

-Interested in electronic mail

-Foresee development of databases for

- License Drawing
- Violators

-In dealing with violators, it would be useful also to have access to Motor Vehicle and Drivers License databases

-Research laboratory in Bozeman is making increasing use of national databases

Approximately 400 employees: 75 in Helena, 70 in 7 Regional Offices; Wardens working out of homes; Fisheries & Biologists

Interviewed: Sharon Garden, Centralized Services Division
Jim Hermann, License Bureau

GOVERNOR'S OFFICE

VOICE

-Voice service is meeting needs

EMERGENCY COMMUNICATIONS

- Governor requires the ability to communicate while in transit within the State; important that the Governor can receive or send critical messages, wherever he is in Montana
- Requires the ability to communicate with the area in the event of a disaster or emergency anywhere in the State
- Requires communications into the broadcast media to reach the public quickly and effectively in the event of an emergency

Interviewed: Ted Schwinden, Governor

DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES

VOICE

- Voice communications is meeting needs
- Considerable voice communications with local health authorities

DATA

- Considerable exchange of information and reporting with Federal agencies; 85% of department budget is from Federal funds, largely earmarked.
- Federal priorities change; considerable emphasis now on toxic waste problems and on AIDS

RADIO

- Concern expressed about need for better coordination of emergency radio needs -- for emergency medical services and for disaster coordination

Interviewed: John Drynan, MD, Director
Bill Opitz, Deputy Director

DEPARTMENT OF HIGHWAYS

VOICE

- Voice service is meeting needs

DATA

- Eleven district and area offices now have IBM System 1 computers
- A Digital Equipment Company VAX computer with a package for Computer-Assisted Design (CAD) has been implemented in Helena Headquarters. Eventually would like to make this capabilities accessible to highway project managers around the state
- Data is now exchanged, some by facsimile, for payroll and personnel information with field offices
- Already 30+ personal computers in the headquarters building, and more coming. Experiencing reduced response time in links with the Mitchell Building mainframe

RADIO

- Converted to high band radio
- Coordinating dispatch with the Highway Patrol

1800 employees, all across the State

Interviewed: John Prebil, Deputy Director
Ron Haraseth, Manager Communications
Mike Randall, Systems and Programming

MONTANA HISTORICAL SOCIETY

VOICE

- Voice service is meeting needs
- Respond by telephone to growing number of research inquiries

DATA

- Project is underway with links to a nationwide database, to catalog the holdings of Montana newspapers, and thus make them more accessible to researchers
- Direct telephone line for typesetting MONTANA magazine
- Possible future links to subscription fulfillment service database in Ohio for MONTANA magazine
- Increasing use of dial-up data access; e.g., to database in Missoula of archeological site information

52 employees in Helena, including 7 at separate Historic Preservation office

Interviewed: Robert Archibald, Director
Brian Cockhill, Administration, Centralized Services

DEPARTMENT OF INSTITUTIONS

VOICE

- Voice service is meeting needs
- Because of the wide distribution of institutions and staffs having 24 hour/day responsibilities, while management is based in Helena, effective communication links are critical

DATA

- The Department is establishing a communications network linked to its own IBM System 38
- Applications to be supported will include:
 - Caseload Management
 - for Corrections
 - including both
 - institutional clients, and
 - outside clients
 - for Mental Health

2300 employees, including 170 in Helena

Interviewed: Curt Chisholm, Deputy Director

DEPARTMENT OF JUSTICE

VOICE

-Voice service is meeting needs

DATA

-Criminal Justice Information Network (CJIN) now supports 80+ terminals in 50 counties, available 24 hours per day

-Use of CJIN is growing rapidly

-Provides direct gateway to FBI files

-CJIN availability is critical, thus a remote back-up system and redundant circuit links are high priority

RADIO

-Working to better integrate the radio network, to improve officer dispatching

-Seeking to improve use of mutual aid frequencies

-Would like a capability to issue an "All Points Bulletin" state-wide

Interviewed: Susan Hansen
Gerry Rymes
Robert Landon
Dutch Meyers

DEPARTMENT OF LABOR AND INDUSTRY

VOICE

- Voice service is meeting needs

DATA

- Automated systems already in place include:
 - Job matching system for Job Service office
 - Benefits automation project for Workers Compensation
- Implementing electronic mail system to link 28 sites
- Pursuing further automation of central office functions, including link to Workers Compensation Building
- Department administrators Statewide Occupational Information Coordinating Committee (SOICC) activity
- The Montana Career Information System (MCIS) is administered under the Department
- Considerable exchange of information with the U. S. Bureau of Labor Statistics

750 employees

Interviewed: Dave Wanzenried, Commissioner
 Rod Sager, Administrator, Centralized Services Division
 Roy Hickman, Data Processing Manager
 Larry DeFrance, Systems Analyst

DEPARTMENT OF STATE LANDS

VOICE

- Voice service is meeting needs

DATA

- Area offices have computers, and data communications needs are increasing
- Bringing a "Trust Land Management System" on line; area offices will want access to this
- Seeking better information dissemination capabilities to field offices

RADIO

- Have extensive mobile radio use -- especially in meeting fire-fighting needs
- Considerable coordination with the U.S. Forest Service, and with other agencies of government

265 employees, including 80 in Helena and 50 in Missoula (approximately 400 in summer)

Interviewed: Dennis Hemmer, Commissioner

LEGISLATIVE COUNCIL

VOICE

-Voice service is meeting needs

DATA

-Heavy use of data links within the Capitol building

-Heavy test composition and printing needs during the Legislative Session; print 40,000-50,000 pages per year

- Reports
- Minutes
- Bill drafting

-Bill status system is accessed on-line by users outside the Capitol

-Batch update of bill status database allows multiple search

44 employees (110 during the Legislative Session)

Interviewed: Lee Heiman

LEGISLATIVE FISCAL ANALYST

VOICE

-Voice Service is meeting needs

DATA

- Office has three terminals linked to the Central Data Center mainframe to support the Legislative Interactive Budgeting system
- Interested in electronic mail; would be particularly valuable during the budget analysis period
- Make use of the National Council of State Legislators database, by dialing up the system based in Denver
- Subscribe to econometrics database

Interviewed: Jim Haubein
Keith Wolcott

STATE LIBRARY

VOICE

- Voice service is meeting needs
- Use the teleconference capability for some meetings

DATA

- Now implementing a Natural Resource Information System based at the State Library
- Will provide on-line access or answers to telephone inquiries
- A number of Montana public and academic libraries share in the Western Library Network (WLN), based in the state of Washington. There are significant telecommunications costs, and the library community is interested in shared network approaches to providing these links
- The State Library is funded now to provide searches of information databases; it is desired that such searches not become fee-based
- More direct home delivery of library materials is foreseen over time

640 libraries in Montana

Interviewed: Sara Parker, State Librarian
Sheila Cates, Coordinator of Library Services

DEPARTMENT OF LIVESTOCK

VOICE

- Voice service is meeting needs.

DATA

- Maintain a Brands database, identifying over 65,000 brands; would like to make this available on-line to inspectors in major cattle markets.
- Certain livestock diseases are required to be reported to the State Veterinarian "by the fastest means possible" to avoid spread; better telecommunications links can support such reporting.
- Access Federal Brucellosis Information database, and other USDA information.
- Access file of information on ranch and farm mortgages.

RADIO

- Inspectors have high band radios; work with sheriff's offices and highway department in communications.

Interviewed: John Skufca, Centralized Services Division
Donald Ferlicka, DVM, State Veterinarian
Lorrane Dressler, Purchasing and Supply Officer

DEPARTMENT OF MILITARY AFFAIRS

VOICE

- Have OPX line to Bozeman for connection with Autovon network
- OPX links also with Fort Harrison and Helena Airport

DATA

- Backup mainframe computer being moved from Mitchell Building to Armory
- New telecommunications links required between Armory and Mitchell Building to interconnect the computers
- Military Affairs has minicomputer systems in Helena Armory and in Bozeman
- Approximately 65% of military operations are based at Fort Harrison, where Federal government has a Burroughs computer
- Disaster and Emergency Services operates with Military Affairs and has satellite link with the Federal Emergency Management Administration (FEMA) communications

RADIO

- Operates SECURE radio system, linking Military Affairs and DES people in counties for use in emergencies

100 people in Department of Military Affairs;
approximately 750 including National Guard.

Interviewed: Maj. Ken Cottrill, Administrator, Centralized Services

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

VOICE

- Voice service is meeting needs
- Teleconferencing capability used for some Board meetings
 - Board of Natural Resources
 - Board of Water Well Contractors
 - Board of Oil and Gas

DATA

- Maintain a Water Rights database in Helena, accessed by Helena people, by the Water Courts people in Bozeman, and by the Billings Water Rights Office
- Oil and Gas office in Billings developing computer applications
- Increased use also of other databases outside Montana through dial-up use

250 employees, with 180 in Helena

Interviewed: John Armstrong, Administrator, Centralized Services
George Cawlfeld
Jerry Smith

OFFICE OF PUBLIC INSTRUCTION

VOICE

-Voice service is meeting needs

DATA

- Developing a "Bulletin Board", providing on-line access for message switching and for exchange of public domain software
- Access EDLINE supported by the Association of Chief State Education Officers
- Other national data base services are used, both by OPI personnel and, with their assistance, by school district personnel, such as
 - ERIC
 - SPECIALNET
 - AGNET
 - VOCNET
 - COMPUERVE

OTHER

- Interested in capabilities of video teleconferencing for instruction and other purposes; Helena Audio-Visual Center now receives such programs

130 in Helena, 56 County Systems, 551 School Districts

Interviewed: Ed Argenbright, Superintendent
Bill Anderson, Deputy Superintendent
Dan Dolan, Mathematics and Computer Education Specialist

PUBLIC SERVICE COMMISSION

VOICE

- Voice service is meeting needs
- Considering an In-WATS number for consumer access

DATA

- Have a data link to the Data Center in the Mitchell Building
- Acquiring additional IBM PC's and more data links
- An IBM System 36 will support
 - Registration of motor carriers (now 6000+ in the database)
- Interested in ability to accept and process machine readable data from the utilities

40 Employees

Interviewed: Madeline Cottrill, Administrator, Centralized Services Div.
Wayne Budt, Administrator, Transportation Division
Dan Elliott, Administrator, Utility Division

DEPARTMENT OF REVENUE

VOICE

-Voice service is meeting needs

DATA

-A number of data processing projects now underway have communications implications:

- Child Support Enforcement offices have personal computers and communications links
- Property Assessment function is being automated; databases in some cases shared with the counties
- Moving toward enabling some state accounting firms to file corporate tax returns on-line
- Terminals in Helena support system for Motor Fuels taxes
- A major rewrite of the Tax Code is being developed and edited in machine-readable form

1036 employees

Interviewed: Jack Ellery, Deputy Director
Brenda Haseman

SECRETARY OF STATE

VOICE

- Voice service is meeting needs
- Respond to inquiries, e.g., on corporation registration

DATA

- Developing an automated system for the Uniform Commercial Code (UCC)
- May later develop a comparable system for corporation registration information
- Considering the provision of on-line access, provided initially to the State's larger law firms and banks
- SB124 requires that public access be provided to information on agricultural liens
- In the longer term, considering automated voter registration files -- with possible links to county clerk's offices

35 employees, all in Helena

Interviewed: Larry Akey, Executive Assistant

DEPARTMENT OF SOCIAL AND REHABILITATION SERVICES

VOICE

- Voice services are meeting needs

DATA

- The need for SRS operations is in inverse proportion to the State of Montana's economy
- The Department has assumed operational responsibility for the thirteen largest county SRS offices
- In forty other counties, the State and counties operate with shared funding
- Because of these county-based responsibilities, a large number of reports and updates are being exchanged
- Now working with an IBM Applications Transfer Team toward implementing on-line database systems for:
 - Vocational Rehabilitation
 - Developmental Disability
 - Contracting System for Economic Assistance
- The income maintenance programs now support 8000+ families in Montana, to provide Aid to Families with Dependent Children and Medicare payments
- This provides payments to more people than the State payroll system
- In determining eligibility, it would be useful for SRS to be able to access:
 - Job Service files
 - Property Assessment files
 - Motor Vehicle files

1100 employees, including offices in all 56 counties

Interviewed: Ben Johns, Deputy Director
Pat Godbout, Administrator, Audit and Program
Compliance Division

SUPREME COURT

VOICE

- Voice service is meeting needs
- Conferencing capability may better support assignment by Justices to District Judges

DATA

- Increasing use in Helena of IBM 5520 word processing system; used by the Court Justice's offices, the Law Library, and the Clerk of the Court
- Inputs of information are increasingly on standardized forms, with a view toward further data processing applications
- Law Library provides dial-up access to WEST LAW and other on-line databases
- Interested in direct update to personnel files and SBAS

40 employees, all in Helena

Interviewed: Mike Abley, Administrator

MONTANA UNIVERSITY SYSTEM

VOICE

- Interested in exploring student access to the State's network
- Would like more detailed telephone accounting capabilities on the campuses
- Making increasing use of teleconferencing for meetings

DATA

- Campuses are acquiring new mainframe computers, and pursuing improved telecommunications linkages among them to support
 - Access from one campus to computing facilities at another
 - Exchange of programs and files
 - Consolidation of student enrollment information and accounting data for system-wide use
- Establishing link to Guaranteed Student Loan processing center in Indianapolis, and perhaps links to Montana banks.
- Interested in improving links and lowering telecommunications costs for campus library use of the Western Library Network (WLN), based in Washington State.

OTHER

- Regents have recommended increased multi-campus cooperation on extended education and other programs, which can be supported through telecommunications
- Television capabilities for inter-campus and off-campus instruction, and for cultural programs, is being explored

Interviewed: Bill Lannan
Paul Dunham
Jack Noble

EASTERN MONTANA COLLEGE

VOICE

-Voice service is meeting needs

OTHER

-Campus will acquire new DEC VAX computers

-KEMC Public radio on important service to the Billings community

Interviewed: Donald Fox, Budget Office
Kenneth Heikes, Administrative Vice President
Edward Neroda, Library Director
Jack Hull, Computer Center
Kenneth Woosley, Director of News and Media

MONTANA COLLEGE OF MINERAL SCIENCE AND TECHNOLOGY, BUTTE

VOICE

- Interested in more detailed telephone accounting capabilities for the campus

DATA

- Using link to Helena mainframe for SBAS
- Have interest in improved exchange of information for personnel and payroll
- Developing a Ground Water Information database on the campus, which will be accessed from other sites
- Increasing use of the campus Computer Center from both on and off-campus -- by
 - Students
 - Faculty
 - School districts
 - Research center

Interviewed: Victor Burt, Director of Fiscal Affairs

EARTHQUAKE STUDIES OFFICE, MONTANA BUREAU OF MINES AND GEOLOGY

NEEDS

- Currently gathers seismic activity information from sites in Southwestern Montana, to record it graphically on equipment in Butte.
- Analog information is carried by low power FM radio to a receiver site outside Butte.
- Functions well spring, summer and fall; but icing on receiver radio antenna renders data unintelligible in winter.
- Interested in any alternatives providing improvement.

Interviewed: Mike Stickney, Director

MONTANA STATE UNIVERSITY

VOICE

- Voice service is meeting needs
- Concerned about slow response time with CMC Directory system terminals
- Cited problems in account code billing
- Interested in more detailed telephone accounting capability for the campus

OTHER

- Interested in establishing quarterly meetings among Universities and the Bureau
- Urge a planning effort to focus public/educational broadcast telecommunications activity in Montana

Interviewed: Marilyn Wessel, Director of Communications
 Craig Roloff, Director, Administrative Services
 Edward Groenhout, Dean, Art and Architecture
 Noreen Alldredge, Dean of Library
 William Moore, Director of Computing Services

UNIVERSITY OF MONTANA

VOICE

- Interested in more detailed telephone accounting capability for the campus
- Problems in using voice grade lines linked on-the-air to KUFM

DATA

- A new DEC VAX 8600 computer will be brought up in December, and a second will be brought on line, with the two coupled as a cluster
- With these additional capabilities, many more campus terminals can be supported (500-600 concurrently); the campus is interested in exploring whether these terminals might be linked through the present telephone system wiring
- With MBA program operating in Billings, expect much telecommunications activity to the Missoula computer
- Foresee much more sharing of information, data, files and programs among the campuses, and with the System administrator

OTHER

- Interested occasionally in satellite or terrestrial links from the campus to broadcast television stations across the State -- to feed programming such as former President Carter's visit next spring.
- University is affiliated with the National University Teleconferencing Network, which currently provides for reception and campus use of instructional programming
- The campus Instructional Materials Center can receive, distribute and/or record and retain educational programming delivered via satellite

Interviewed: Leonard Lewis, Data Processing Manager
Steve Henry, Computer Center Manager
Ken Fielding, Director, Telecommunications

NORTHERN MONTANA COLLEGE

VOICE

- Pleased with new SL1 system, installed in August, 1985
- Campus employee is trained to handle telephone moves, adds and changes; working well

OTHER

- Have installed a DEC VAX computer with a number of campus terminals
- Grant application made to NTIA U.S. Department of Commerce, to establish public radio and public television facilities on the campus
- Library interested in automation efforts

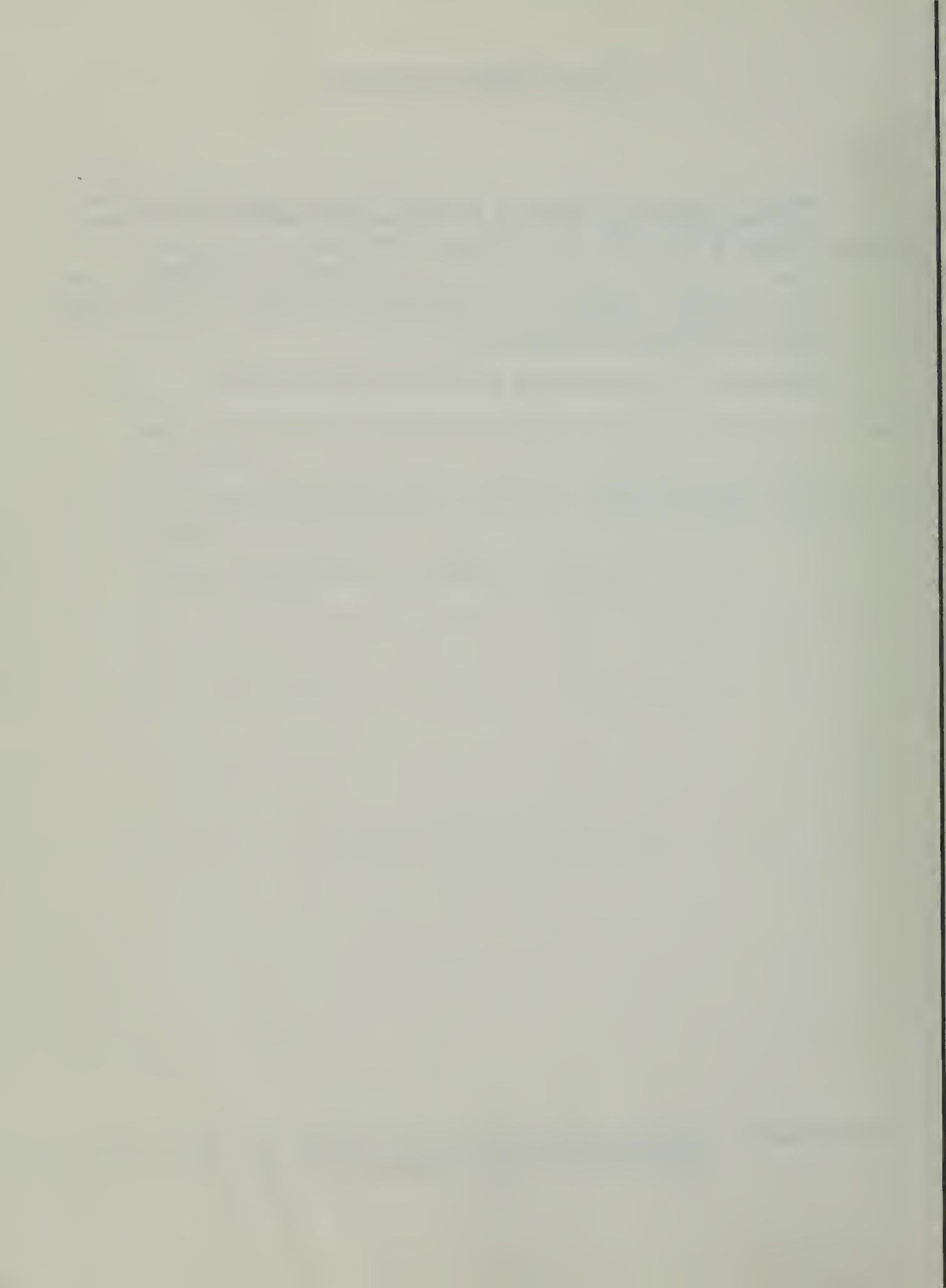
Interviewed: Lou Lucke, Computer Services Director
Terrence Thompson, Director of Library

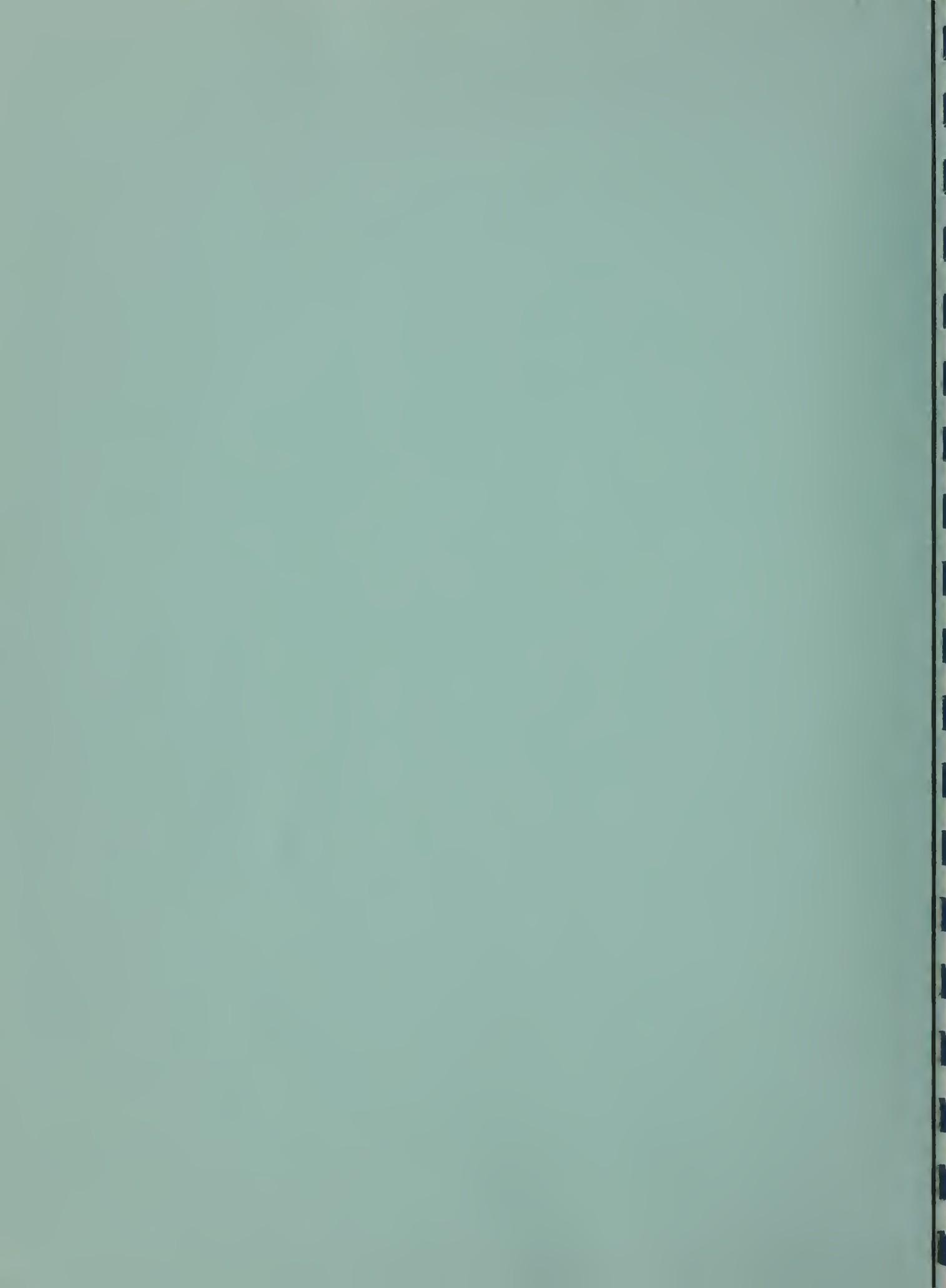
MILES COMMUNITY COLLEGE

NEEDS

- The College has a Title III grant from the U.S. Office of Education to investigate the use of interactive television to support instructional needs in Southeastern Montana
- Working with local school districts, with the University System, and with other agencies in developing programs through which, e.g., language, science and mathematics instructors can reach multiple classes simultaneously
- Interested in coordinating with our network planning

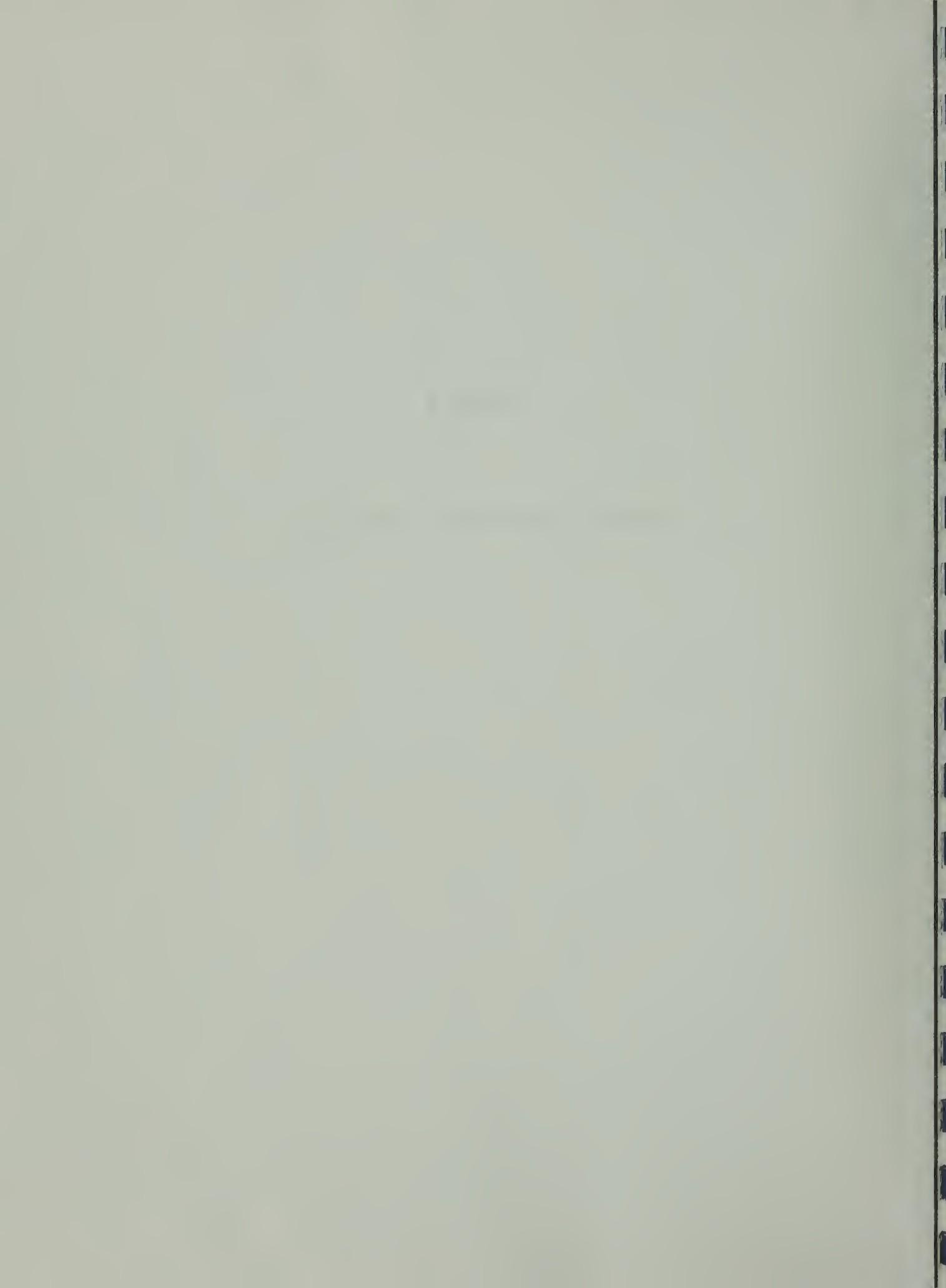
Interviewed: John Koch, Dean
Syd Sonneborn, Director MCC-ITV





APPENDIX C

PRESENT WORTH ECONOMIC CALCULATIONS

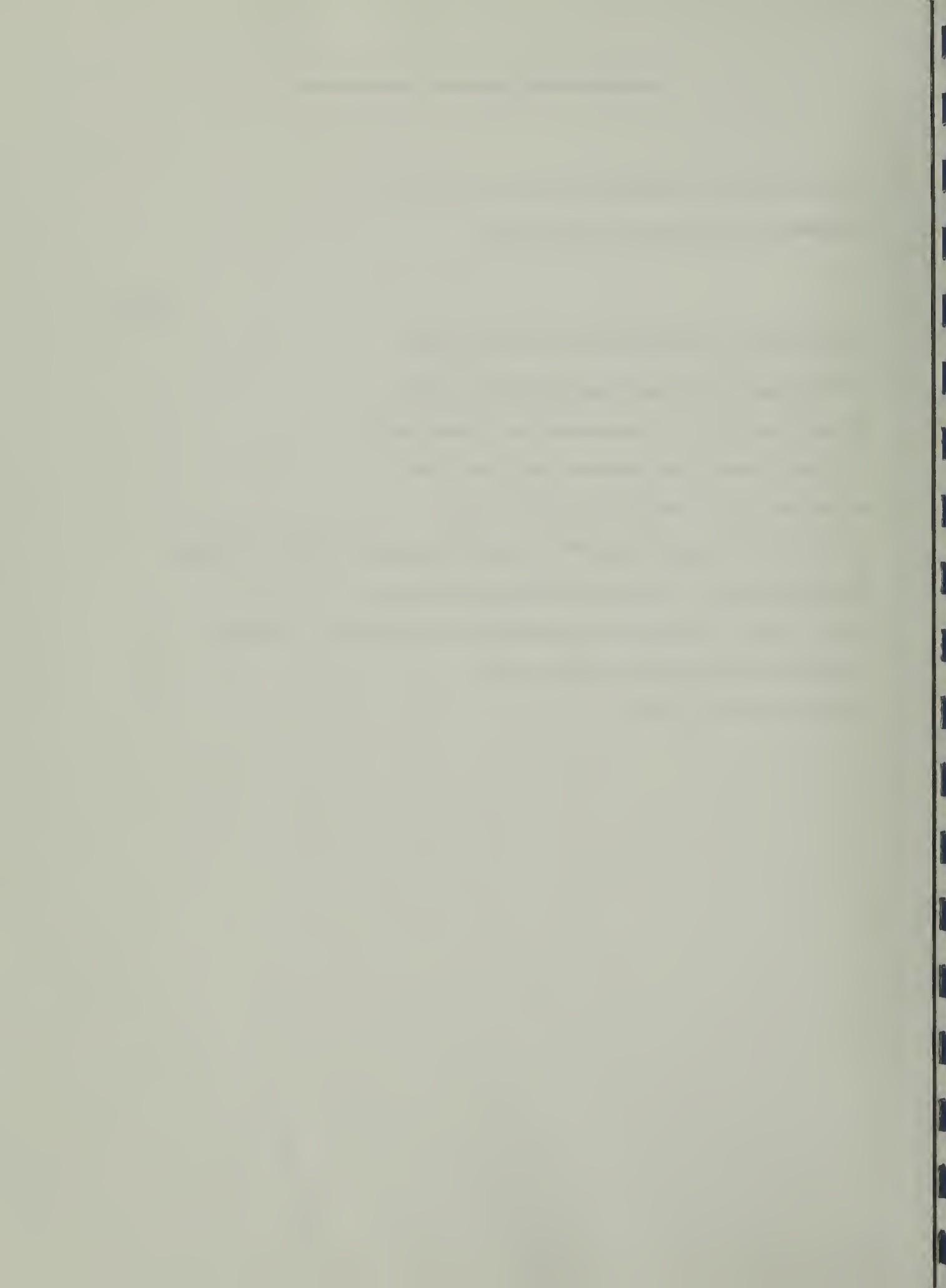


Present Worth Economic Calculations

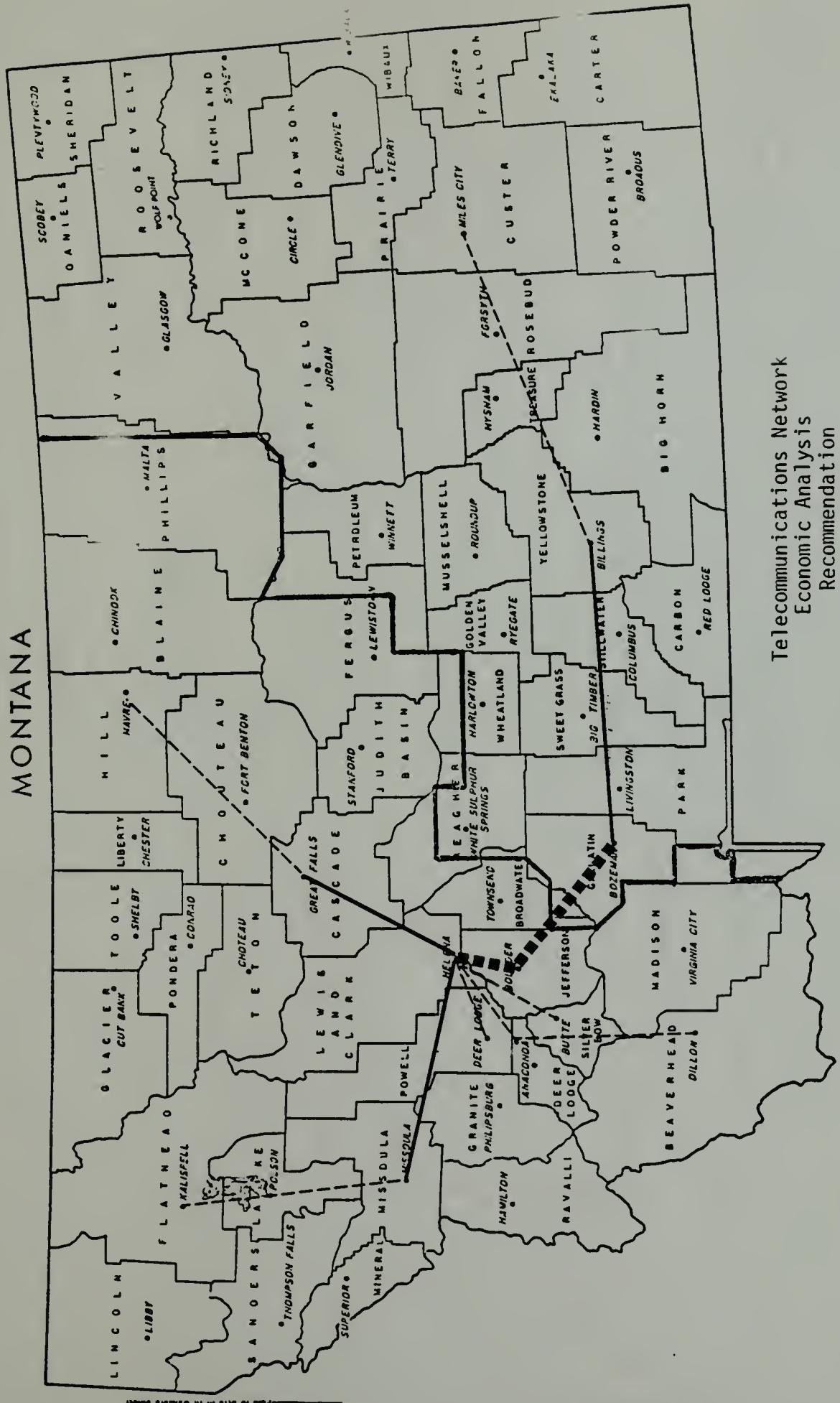
Economic Analysis Recommendations Facilities Map

Fundamental Plan Microwave Routing Map

	<u>Section</u>
Helena-Bozeman Telecommunications Route Study	1
Helena-Missoula Telecommunications Route Study	2
Helena-Great Falls Telecommunications Route Study	3
Billings-Bozeman Telecommunications Route Study	4
Helena-Butte Telecommunications Route Study	5
Helena-Warm Springs, Helena-Deer Lodge Telecommunications Route Study	7
Missoula-Kalispell Telecommunications Route Study	8
Satellite/Earth Station Telecommunications System Study, 5 Cities	9
Small Earth Terminal Data Systems Study	10
Fiber Optic Route Study	11



MONTANA

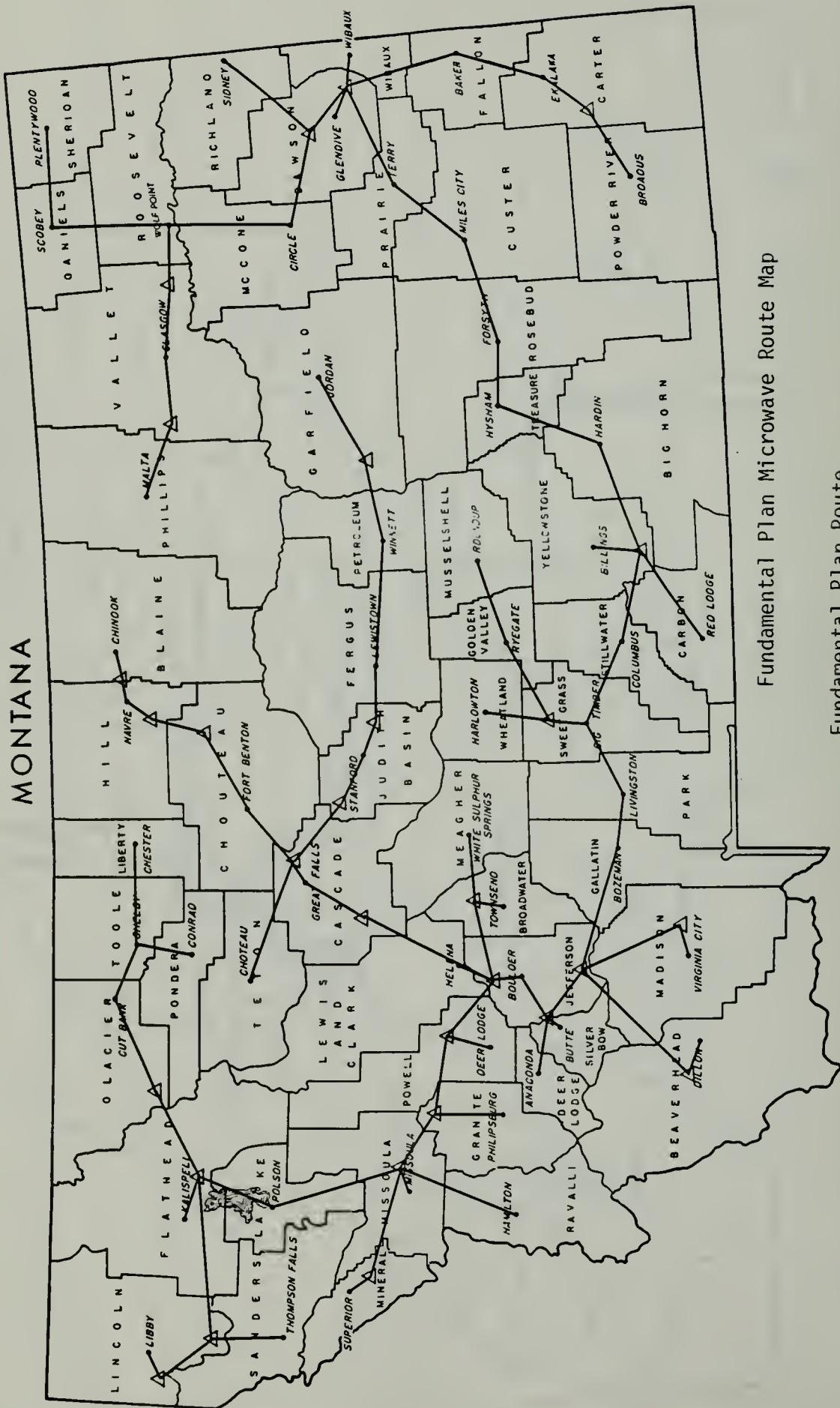


Telecommunications Network
Economic Analysis
Recommendation

■ ■ ■ ■ ■ Microwave Radio

— — — T1 Circuits, Near Term

MONTANA



Fundamental Plan Microwave Route Map

Fundamental Plan Route



SECTION 1

HELENA-BOZEMAN

TELECOMMUNICATIONS ROUTE STUDY



HELENA-BOZEMAN ROUTE CIRCUIT REQUIREMENTS

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Helena-Bozeman, 10FX, 20 tie-lines, 2 data	34	35	37	38	40	41
Helena-Billings, 22 voice, 3 data	27	28	29	30	32	33
Bozeman-Missoula, 6 voice	7	7	8	8	8	9
Billings-Missoula, 6 voice	7	7	8	8	8	9
Adjustment for rounding	<u>0</u>	<u>1</u>	<u>-1</u>	<u>0</u>	<u>0</u>	<u>0</u>
TOTAL	75	78	81	84	88	92

5% added to 1986 requirement to account for estimated overflow to discounted toll on the present system.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

The radios on this route are 192 channel capacity.

The Helena-Bozeman route is unique because Mountain Bell is legally prohibited from transporting circuits across the LATA line which has been imposed between Helena and Bozeman. Circuits are routed via Billings on AT&T facilities and backhauled to Bozeman on Mountain Bell facilities. This routing results in an unusually high circuit cost between Helena and Bozeman.

Five plans are compared in this analysis:

1. Conventional leased circuits routed via Billings
2. T1 Circuits. The transmission medium would be owned by one of the common carriers and the channel banks would be State owned.
3. Microwave radio and T1 channel banks. All facilities would be State owned. Boulder is a repeater point and could have access to the network at a small additional expense (not included in these costs).
4. Conventional circuits routed directly from city to city for all the circuits included in the cross section. This is the total cost of these circuits under the present routing. To compare these results with any of the other plans, a factor has been developed to add to each of the other plans to cover the extension of the circuits from Helena and Bozeman to their respective destinations.
5. Conventional circuits routed directly between Helena and Billings using intra-LATA charges. This plan is for illustration only. Federal regulation prevents Mountain Bell from offering this service.

The map illustrates the physical routing of the circuits.

The economic selection study work sheets for each plan include the quantities and costs of all facilities, the annual charges and the calculations.

Summary of Results

Present Worth of

	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$5,415,637	Conventional circuits
Plan 2	2,040,657	T1 circuits
Plan 3	1,574,784	Microwave Radio
Plan 4	4,761,131	Conventional circuits routed directly
Plan 5	1,674,659	Conventional circuits without LATA restrictions
Comparison		
Factor	1,321,525	Add to plans 1,2,3, and 5 to compare with plan 4

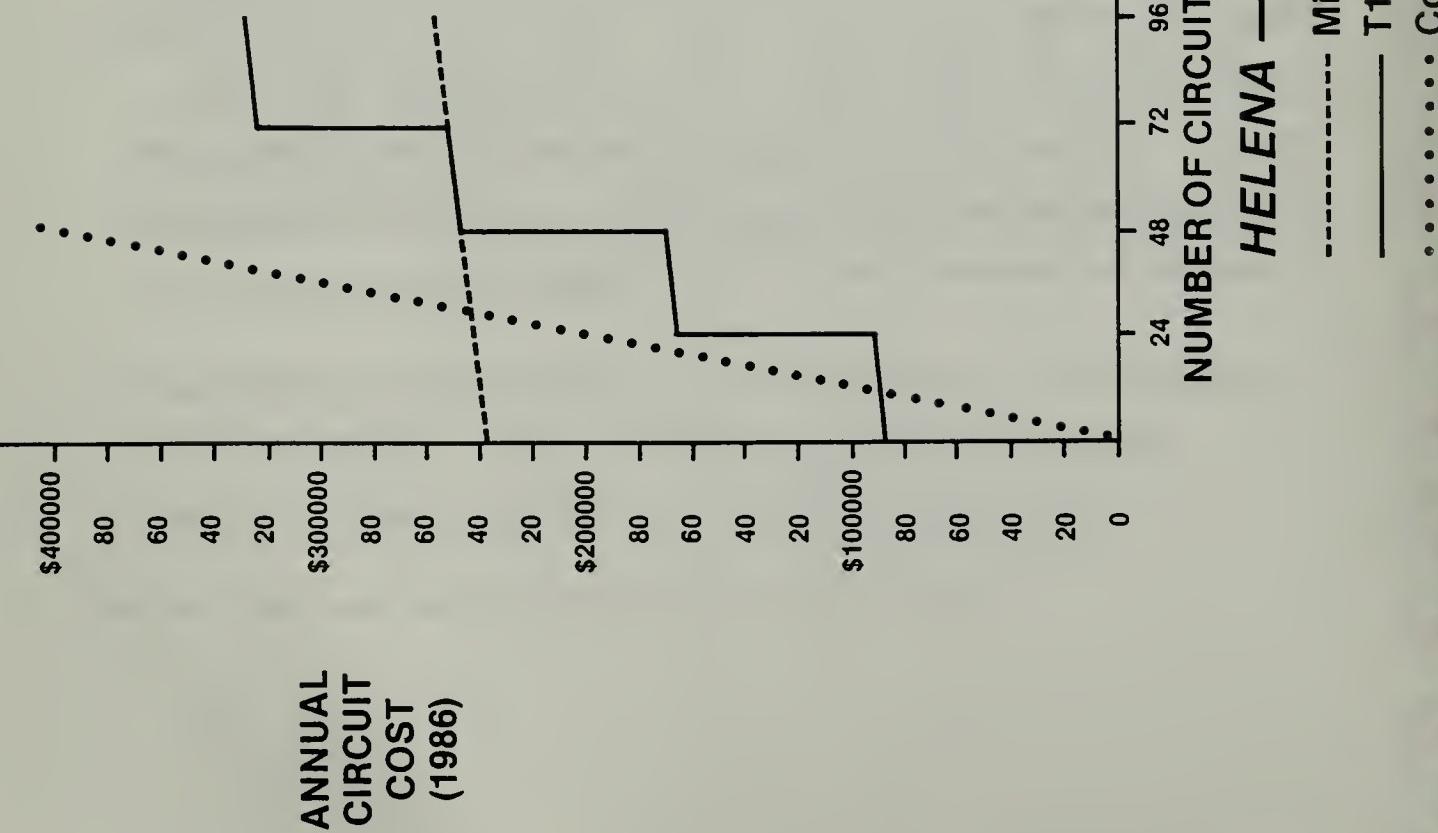
The results indicate that microwave radio is the most cost effective method of providing circuits in this route for the circuit quantities used in the analysis. T1 circuits are also economical and would be less expensive than microwave radio at lower circuit requirements. The cost relationships are illustrated in the annual costs for circuit graph.

Current circuit requirement is 75

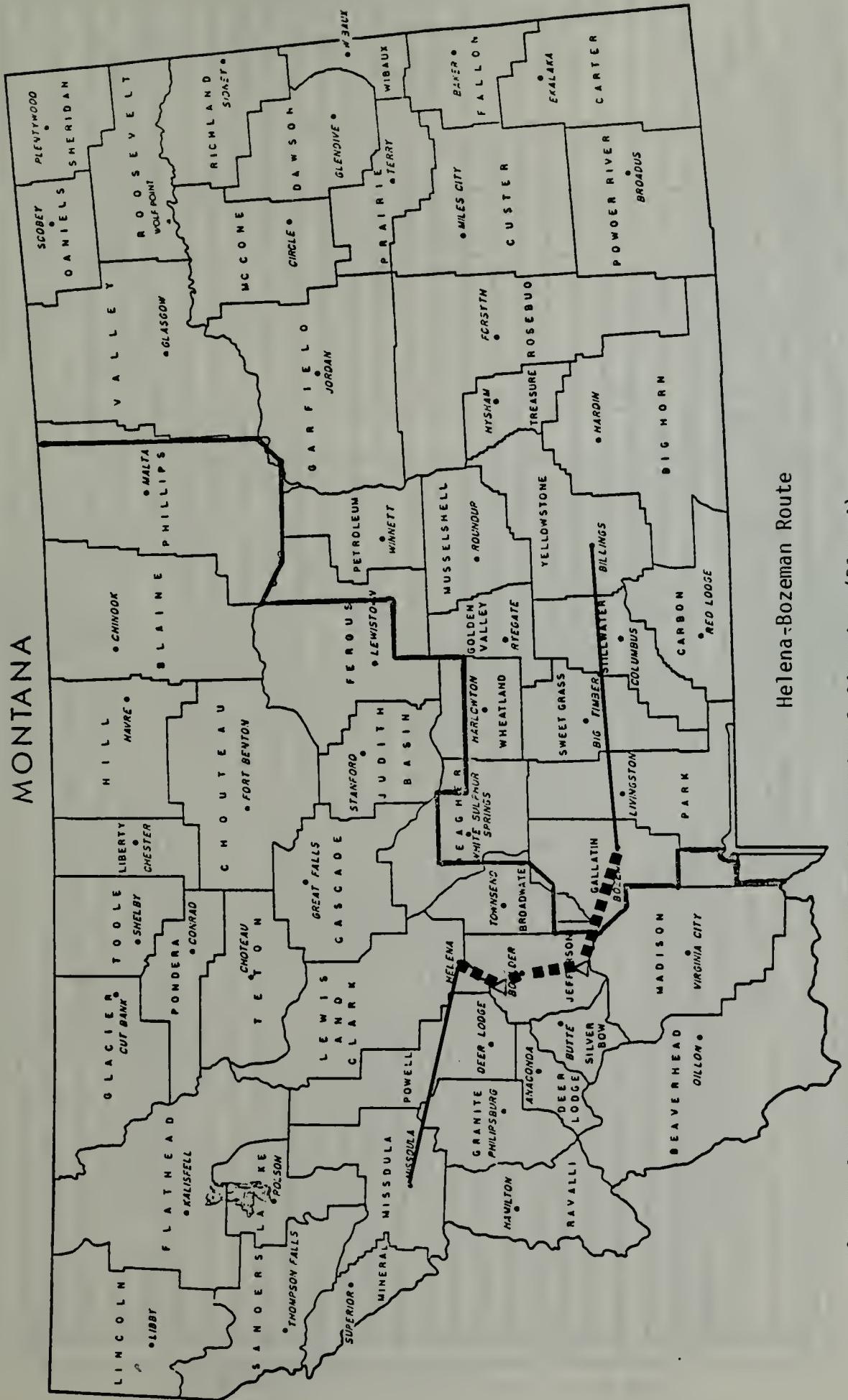
T1 is less expensive than conventional circuits after the 11th circuit.

Microwave is less expensive than conventional circuits after the 29th circuit.

T1 and microwave are approximately equal from the 49th to the 72nd circuit. Thereafter microwave is less expensive.



MONTANA



Helena-Bozeman Route

Conventional Circuits (Plan 4)

■ ■ ■ ■ ■ Microwave Radio Route

County Seat

Repeater

△

△

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Bozeman Telephone Communications Route
Conventional Circuits

Run # 5 of 5 Sheet # 1 of 1
Prep. by W. Date 86 thru 95
Study Period

CAPITAL REQUIREMENTS

ITEM	QUANTITY	MONTHLY UNIT COST	FIRST-COST		PRESENT-WORTH OF FIRST-COST		ANNUAL COST		REVENUE REQUIREMENTS		PRESENT WORTH OF ANNUAL COSTS
			CONTRACT AMOUNT	DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	AMOUNT	PERIOD	FACTOR	
1. Helena - Bozeman Circuits	78	6.52	X 12.564	86			6.38, 953	/0	C. 144	3, 925, 740	
2. % per year	3	7.46	"	88			2.5, 118	10-3	4, 408	623, 944	
3. increase in circuit requirement	3	8.55	"	90			3.2, 227	10-4	2.974	95, 843	
4. requirement	3	9.78	"	92			3.6, 863	10-6	1.759	65, 943	
5.	4	11.20	"	94			5.6, 287	10-8	.809	95, 536	
6.											
7. Circuit Cost Additions	7.8	9.3	X 12.564	88			91, 139	10-2	4.408	401, 741	
8. 7% /year	81	10.9	"	90			110, 928	10-4	2.974	329, 900	
9.	84	12.3	"	92			129, 811	10-6	1.789	332, 232	
10.	87	14.2	"	94			155, 216	10-8	.809	125,	
11. Total										5, 346, 953	
12. One-Time Installation	46	1208		86	1.0					55, 528	
13. Charge Increased at Existing	3	1383		88						3, 429	
14. 7% /year	3	1583		90						3, 244	
15. circuits deducted from 86 quantity	3	1812		92						3, 069	
16. quantity Total	4	2076		94						3, 874	
17.											
18.											
19.											
20.											

REMARKS: Present worth of annual + factor for 12 monthly payments in advance of year end payment date = 1.047.
 $1.2 \times 1.047 = 1.2 \cdot 564$

NON-STANDARD ANNUAL COST PERCENTAGES

TYPE OF PLANT	(1)	(2)	(3)	(4)	(5)
C of M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL \$					

ECONOMIC SELECTION STUDY

DESCRIPTION:

Helen - Bogen - T1 Communications Route
T1 Circuit,

PLAN 2 OF 5 SWEET OF 1
PREP. BY M DATE 12/26/85
STUDY PERIOD 1986 thru 1995

CAPITAL REQUIREMENTS

REVENUE REQUIREMENTS

ITEM	QUANTITY	UNIT COST	PRESENT WORTH OF FIRST COST	ANNUAL COST			PRESENT WORTH OF ANNUAL COSTS		
				DATE OF EXPEND.	AMOUNT	PER CENT	AMOUNT	PERIOD FACTOR	AMOUNT
1 Channel Block Comm. Equip.	8	6,000	48,000	86	1.0	48,000	22.7	10	66,645
2 Channel Units	156	260	40,560	86	1.0	40,560	22.7	10	6,144
3 Channel Units	6	260	1,560	88	.864	1,289	22.7	354	575.68
4 Channel Units	6	260	1,560	90	.830	1,065	22.7	354	1,570
5 Channel Units	6	260	1,560	92	.805	881	22.7	354	1,053
6 Channel Units	8	260	2,080	94	.785	970	22.7	472	1,789
7 Total									6,233
8 Monthly Rent, Long Distance Connection							92,765		
9 T1 Facility, Helen - Bogen	4	5,000	20,000	x/24	1.047	251,280		10	6,144
10									1,543,864
11 Local Connection	2	1,000	2,000	x/12X	1.047	251,280		10	6,144
12 Local Connection	6	400	2,400	x/12X	1.047	251,280		10	6,144
13 Total									1,543,864
14 Time Charge / ^{1st} T1	1	2,400	2,400	86	1.0	2,400		10	6,144
15 Time Charge Additional T1s	3	1,400	3,600	86	1.0	3,600		3,400	
16 Time Charge 1st Local Con.	2	6000	12,000	86	1.0	12,000		3,600	
17 Time Charge Additional L.C.	6	3,000	12,000	86	1.0	12,000		12,000	
18 Total							30,000		12,000
19									
20 Total									2,040,657

REMARKS: Channel Banks owned by State.
T1 Facilities paid monthly.

NON-STANDARD ANNUAL COST PERCENTAGES		
TYPE OF PLANT	11	12
C OF M	10.0	
PROPERTY TAX	0	
INCOME TAX	0	
DEPRECIATION	6.7	
MAINTENANCE	6.0	
TOTAL	22.7	

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Bozeman Telecommunications Route
Microwave Radio And T1 Channel Banks

PLAN 3 OR 5 SWEET 1 OF 2
PREP. BY M DATE 1955
STUDY PERIOD 1956 - 1955

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS		REVENUE REQUIREMENTS			PRESENT WORTH OF ANNUAL COSTS	
			PRESENT WORTH OF FIRST COST	DATE OF EXPEND.	AMOUNT	PER CENT	AMOUNT	PERIOD FACTOR	AMOUNT
1 Digital MW Radios, Term.	2	\$4,600 /09800	86	1.0	/09 800	22.7	24925	10	6.144
2 Digital MW Radios, Rptr.	6	\$0,400 302400			302 400	22.7	68645		421 755
3 Antennas, Systems	8	\$4000 72000			72 000	22.7	16344		100 918
4 Battery & Power	5	\$5,600 28000			28 000	22.7	6356		39 051
5 AC Generator	5	\$35000 175000			175 000	21.7	37975		233 318
6 Spares	1 Lot	\$50,000 50000			50 000	22.7	11350		69 734
7 Land and Site Work	2	\$30,000 60000			60 000	18.0	10800		66 355
8 Buildings	2	\$25,000 50000			50 000	21.7	10850		66 662
9 Site Work at Exist. Bldgs	3	\$5,000 /5000			/5 000	21.7	3255		19 949
10 Towers 150 ft	2	\$1,000 124000			124 000	21.7	36908		165 334
11 Tower, Stub 30 ft	3	\$1,000 48000			48 000	21.7	3212		19 736
12 Survey, FCC License, Engg. Card / Lot	1/4	\$1000 14800			14 800	16.7	2472		151 88
13 System Design		\$75,000 75000			75 000	16.7	13525		76 954
14 Channel Bank Comm. Equip.	8	\$6,000 48000			48 000	22.7	10896		66 945
15 Channel Units	156	\$40,560 40,560	▼		40 560	22.7	9207	▼	56 568
16 Channel Units	6	\$260 1,560	88		.8269	1289	21.7	354	1560
17 Channel Units	6	\$260 1,560	90		.6830	1065	22.7	354	10-4 2.974
18 Channel Units	6	\$260 1,560	92		.5645	881	22.7	354	10-6 1.789
19 Channel Units	8	\$360 2,080	94		.9465	970	22.7	472	10-8 .804
20 Total									382
									1,574,784
REMARKS:	Costs are installed costs. Depreciation based on 15 year life, straight line. Maintenance includes labor and materials in State employee supervision (administrative). Survey and Design work annual charges have no maintenance content.								
	(1)	(2)	(3)	(4)	(5)				
TYPE OF PLANT	MW+MUX	Towers	Buildings	Land	A.C. Gen				
C OF M	/0	/0	/0	/0	/0				
PROPERTY TAX	0	0	0	0	0				
INCOME TAX	0	0	0	0	0				
DEPRECIATION	6.7	6.7	6.7	6.7	6.7				
MAINTENANCE	6	5	5	5	5				
TOTAL \$	22.7	21.7	21.7	18	21.7				21.7

NON-STANDARD ANNUAL COST PERCENTAGES		
(1)	(2)	(3)
TYPE OF PLANT	MW+MUX	Towers
C OF M	/0	/0
PROPERTY TAX	0	0
INCOME TAX	0	0
DEPRECIATION	6.7	6.7
MAINTENANCE	6	5
TOTAL \$	22.7	21.7

ECONOMIC SELECTION STUDY

DESCRIPTION:

Helicon - Boggsman Telecommunications Route
Microwave Radio and T1 Channels / Bunks

Remaining Life Credit.

ITEM	First Qualifying Cost	Credit Unit Factor	Present Worth of First Cost	ANNUAL COST			REVENUE REQUIREMENTS		
				DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	AMOUNT	PERIOD FACTOR
1 Digital MW Radio	1124500	.333	374,428	96	.3855	144,361			
2 System including Radios									
3 Antennas, Batteries									
4 Generators, Spares									
5 Buildings, Towers, Survey									
6 Design and Site Work and Initial Channels									
7									
8 Land, Properties Sites	40,000	1.00	40,000	96	.3835	15,420			
9									
10 Channel Units	1560	.467	729	96	.3855	281			
11									
12	1560	.60	936	96	.3855	361			
13	1560	.733	1143	96	.3855	441			
14	2080	.867	1903	96	.3855	734			
15									
16									
17									
18									
19									
20 Total							161,598		

TYPE OF PLANT	C OF M	PROPERTY TAX	INCOME TAX	DEPRECIATION	MAINTENANCE	TOTAL \$
	(1)	(2)	(3)	(4)	(5)	

NON-STANDARD ANNUAL COST PERCENTAGES						

PRESENT WORTH OF ANNUAL COSTS						

PRESENT WORTH OF ANNUAL COSTS						

PRESENT WORTH OF ANNUAL COSTS						

PRESENT WORTH OF ANNUAL COSTS						

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PRESENT WORTH OF ANNUAL COSTS						

PRESENT WORTH OF ANNUAL COSTS						
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ECONOMIC SELECTION STUDY

DESCRIPTION:

Helena - Bozeman
Circuits Routed Directly - Common Carrier

PLAN 4 OF 5 SHEET 1 OF 2
PREP. BY M. DATE 1/95
STUDY PERIOD 1982 thru 1995

ITEM	QUANTITY	UNIT COST	PRESENT-FIRST-COST	DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS		
							ANNUAL COST	PER CENT	AMOUNT
1 Helena - Bozeman	34	652	X 1/2 X 1.047	86			2,78, 5/10	2	1,736
2 Helena - Billings	27	496	X 1/2 X 1.047	86			1,68, 2/51	2	1,736
3 Bozeman - Missoula	7	752	X 1/2 X 1.047	86			66, 1/34	2	1,736
4 Billings - Missoula	7	596	X 1/2 X 1.047	86			52, 4/15	2	1,736
5 Total									90, 993
6 Helena - Bozeman	35	746	X 1/2 X 1.047	88			3,28, 0/46	4-2	1,434
7 Helena - Billings	28	568	X 1/2 X 1.047	88			199, 8/18	4-2	1,434
8 Bozeman - Missoula	7	861	X 1/2 X 1.047	88			75, 7/23	4-2	1,434
9 Billings - Missoula	7	682	X 1/2 X 1.047	88			59, 9/81	4-2	1,434
10 Total									86, 0/2
11 Helena - Bozeman	37	855	X 1/2 X 1.047	90			3,97, 4/62	6-4	1,485
12 Helena - Billings	29	650	X 1/2 X 1.047	90			2,36, 8/31	6-4	1,485
13 Bozeman - Missoula	8	986	X 1/2 X 1.047	90			99, 1/05	6-4	1,485
14 Billings - Missoula	8	781	X 1/2 X 1.047	90			78, 5/00	6-4	1,485
15 Total									93, 0/2
16 Helena - Bozeman	38	978	X 1/2 X 1.047	92			4,66, 9/27	8-6	1,980
17 Helena - Billings	30	744	X 1/2 X 1.047	92			2,80, 4/28	8-6	1,980
18 Bozeman - Missoula	8	1,229	X 1/2 X 1.047	92			113, 4/28	8-6	1,980
19 Billings - Missoula	8	894	X 1/2 X 1.047	92			89, 8/58	8-6	1,980
20 Sub-Total									88, 0/1
									3,826, 7/2

REMARKS: See page 1 of Plan 1 for Rate Increase Percentages.

These circuits represent the present facility routing of the circuit.

TYPE OF PLANT	NON-STANDARD ANNUAL COST PERCENTAGES
C OF M	(1)
PROPERTY TAX	(2)
INCOME TAX	(3)
DEPRECIATION	(4)
MAINTENANCE	(5)
TOTAL %	(5)

ECONOMIC SELECTION STUDY

Helen - Bozeman Telecommunications Route
Circuits Routed Directly - Common Carrier

(continuation)

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AN 4 OF 5 SHEET 2 OF 2
PREP. BY M. DATE
STUDY PERIOD 1982 Nov. 1985

REMARKS: Installation Charge for additional study circuits during year 1986 was not included because it would not be incurred if the method of operation does not change. The additional circuit costs are included to represent traffic cost of overflown transcircuits such as WATS.

ECONOMIC SELECTION STUDY

DESCRIPTION:

Helens - Bogemz Tel/communications Route
Conventional Circuits - No LATA (See note)

THE ECONOMIST

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ECONOMIC SELECTION STUDY

DESCRIPTION:

• Helena - Bozeman Telecommunication Route Factors To Add To Plans For Comparison With Current

PLAN 2-3-5 OF 1 SWEET 1 OF
PREP. BY 1 DATE —
STUDY PERIOD 8c thru 9:55







SECTION 2

HELENA-MISSOULA

TELECOMMUNICATIONS ROUTE STUDY



Three plans are compared in the analysis of the Helena-Missoula route as follows:

1. Conventional circuits as used at present
2. Microwave radio with T1 channel banks, all facilities are State owned.
The terminal at Helena and the first repeater have reduced costs because it is assumed that they have been installed for the Helena-Bozeman route.
3. T1 circuits. The transmission medium would be owned by a common carrier and the channel banks would be State owned.

Summary of Results

Present Worth of

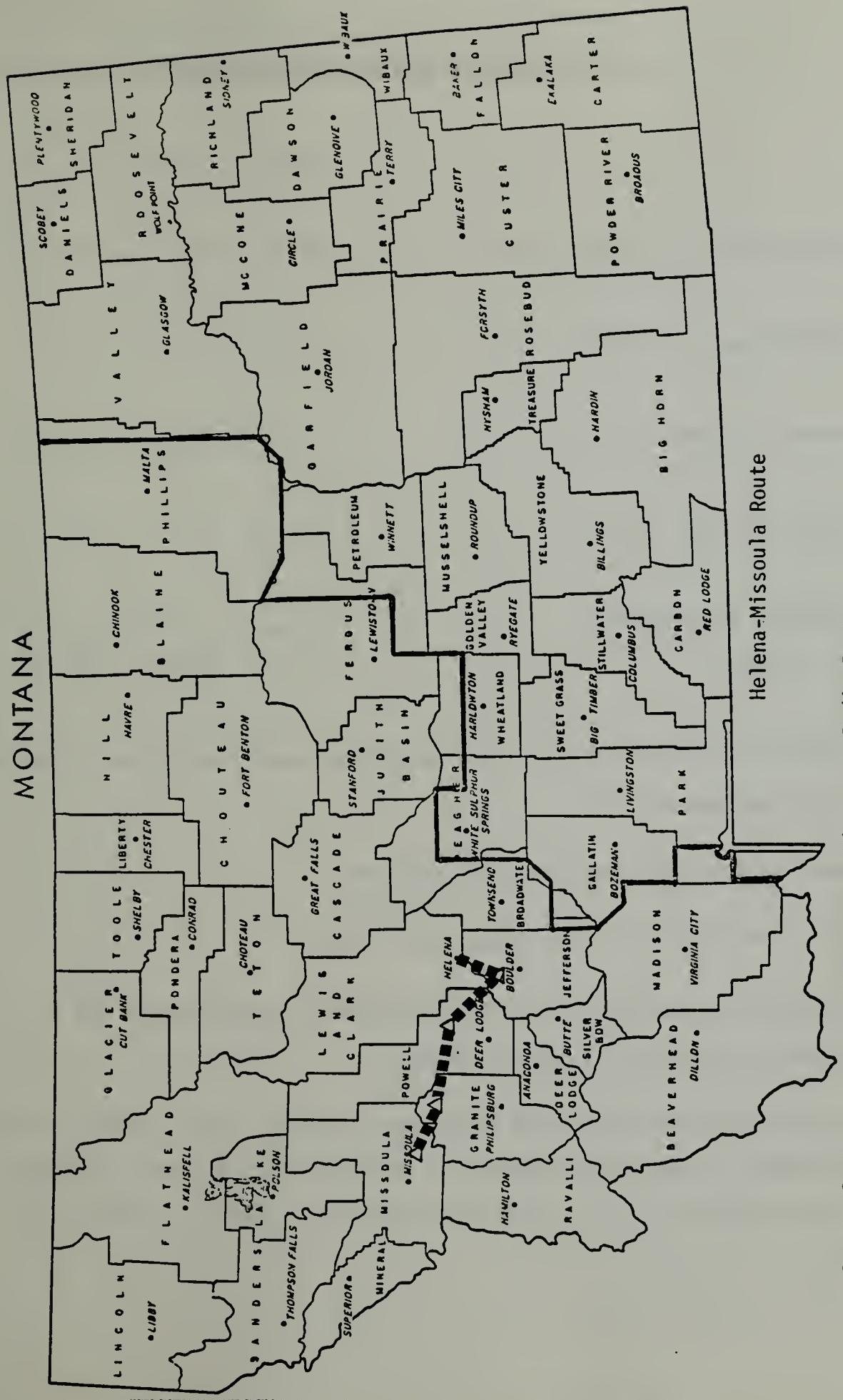
	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$1,136,442	Conventional circuits
Plan 2	1,551,223	Microwave Radio
Plan 3	665,580	T1 Circuits

The results indicate that T1 is clearly the most cost effective method of providing circuits in this route for the quantities of circuits used in the analysis. The cost relationships for 1986 are illustrated in the annual costs per circuit graph. Note also that the conventional circuits would increase in cost at a compounded rate of 7% per year, while the other methods of providing circuits would remain relatively constant. The conventional circuit line on the graph would swing further toward the vertical on the graph each year.

The map illustrates the physical routing of the microwave system.

The economic selection study work sheets for each plan include the quantities and costs of all facilities, the annual charges and the calculations.

MONTANA



Helena-Missoula Route

County Seat

Microwave Radio Route

Repeater

HELENA-MISSOULA ROUTE CIRCUITS REQUIREMENTS

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Helena-Missoula, 27 voice , 1 data	29	31	32	33	34	36
Helena-Kalispell, 1 data	1	1	1	1	1	1
Missoula-Billings, 6 voice	6	6	7	7	7	7
Missoula-Bozeman, 6 voice	6	6	7	7	7	7
Adjustment for rounding	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>1</u>
TOTAL	43	45	47	48	50	52

5% added to 1986 requirements to account for estimated overflow to discounted toll on the present system.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per annum.

48 circuits are installed initially. Additional common equipment and 4 channels are installed in 1992 for growth.

Missoula-Helena has 2 terminals and 4 repeater sites. One repeater site would be in place if the Helena-Bozeman route was installed. The Helena terminal and the repeater site costs reflect the additional equipment added for this route.

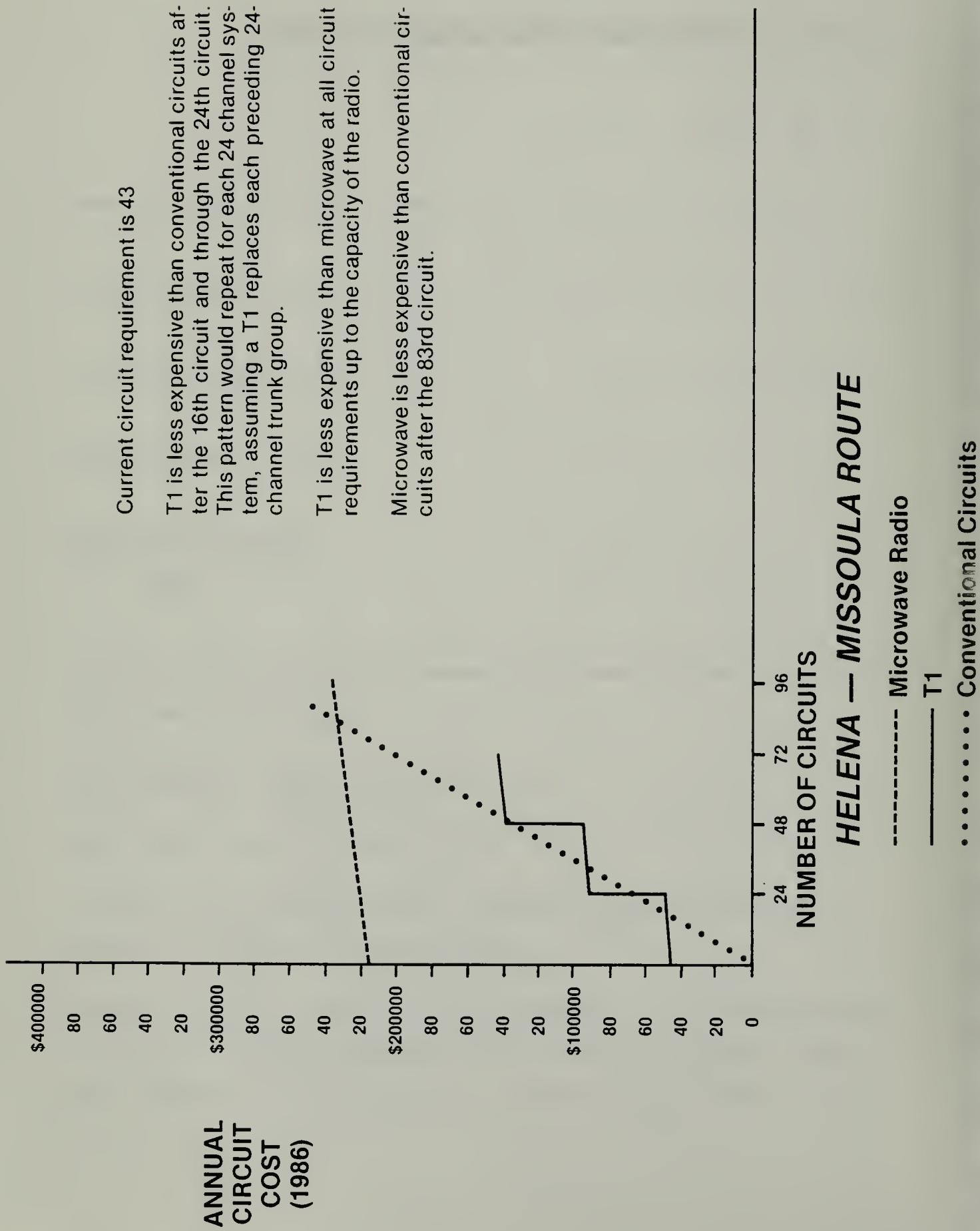
The radios on this route are 96 channel capacity.

Current circuit requirement is 43

T1 is less expensive than conventional circuits after the 16th circuit and through the 24th circuit. This pattern would repeat for each 24 channel system, assuming a T1 replaces each preceding 24-channel trunk group.

T1 is less expensive than microwave at all circuit requirements up to the capacity of the radio.

Microwave is less expensive than conventional circuits after the 83rd circuit.



ECONOMIC SELECTION STUDY

DESCRIPTION: Helene - Missoula Telephone Communications Route
T1 Circuits

MAN 3 or 3 MEET 1 OF 1
PREP. BY _____ DATE _____

STUDY PERIOD

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS			REVENUE REQUIREMENTS		
			FIRST COST	PRESENT WORTH OF FIRST COST	ANNUAL COST	PER CENT	AMOUNT	PERIOD FACTOR
1 Channel Bank Comm. Equip	4	6000	24,000	86	1.0	24,000	22.7	5,448
2 Channel Units	96	240	24,960	86	1.0	24,960	22.7	5,666
3								
4 Channel Bank Comm. Equip	2	6000	12,000	92	.5155	6,774	22.7	1,538
5 Channel Units	8	240	2,080	92	.5155	1,174	22.7	267
6								
7								
8								
9 T1 Facility	2	33332	12,564	86		83,726		10
10 T1 "	1	33332	12,564	92		91,863		10-6
11								
12								
13 T1 Charge 1st Ckt	1	2100		86	1.0			2,100
14 T1 Charge Subsequent	1	1700		86	1.0			1,700
15 "	1	1700		92	.5257			920
16								
17 Total								665,580
18								
19								
20								

NOTES:

T1 cost come from Mt. Bell based on 5 year contract

TYPE OF PLANT	(1)	(2)	(3)	(4)	(5)
C of M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL \$					

NON-STANDARD ANNUAL COST PERCENTAGES

ECONOMIC SELECTION STUDY

DESCRIPTION:

Helen - Missouri /
Conventional Circuits

PLAN 3 OR 4 SHEET 1 OF 1
PREP. BY M. DATE 9-5
STUDY PERIOD 86-71 to 95

CAPITAL REQUIREMENTS

ITEM	QUANTITY	UNIT COST	PRESENT WORTH OF FIRST COST CONVERT TO ANNUAL ¹	ANNUAL COST			REVENUE REQUIREMENTS			PRESENT WORTH OF ANNUAL COSTS
				DATE OF EXPEND.	FACTOR	PER CENT	AMOUNT	PERIOD	FACTOR	
1 Helen - Mission 1/2 Ckts	48	2.24 X 12.564	86	135,088				10	0.144	82,9981
2	4	3.36 X 12.564	92	16,886				10-6	1.789	30,209
3										
4										
5 Ckt cost add. 4.6% 770/1500	48	15.68 X 12.564	87	9,456				10-1	5.235	49,5502
6				16.78	88	10,120		10-2	4.408	44,609
7				17.95	89	10,825		10-3	3.657	39,582
8				19.21	90	11,826		10-4	2.974	35,170
9				20.53	91	12,393		10-5	2.3553	29,161
10				21.91	92	14,354		10-6	1.789	25,679
11				23.33	93	15,373		10-7	1.226	19,616
12				25.18	94	16,451		10-8	.809	13,309
13				26.94	95	17,601		10-9	.385	6,726
14										
15										
16 One Time Installation Chg	20	577	86	/	11,540					
17	4	577	92	.5545	1,303					
18										
19										
20										

REMARKS:

Deducted existing ckt's from one time charge
Quantity

NON-STANDARD ANNUAL COST PERCENTAGES		
TYPE OF PLANT	(1)	(2)
C OF M	(3)	(4)
PROPERTY TAX		(5)
INCOME TAX		
DEPRECIATION		
MAINTENANCE		
TOTAL %		

ECONOMIC SELECTION STUDY

DESCRIPTION:

Helena - Mission / 3 Tc/economical Radio
Microwave Radio and T1 Channel Blocks

Plan 2 of 3 Sheet 1 of 3
PREP. BY My DATE 95
STUDY PERIOD 86 thru 95

CAPITAL REQUIREMENTS

ITEM	QUANTITY	UNIT COST	FIRST COST	PRESENT WORTH OF FIRST COST		ANNUAL COST		REVENUE REQUIREMENTS		PRESENT WORTH OF ANNUAL COSTS	
				AMOUNT	DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	AMOUNT		
1	Microwave Radio Equip.										
2	Terminal Site Complete	1	135,500	86	1.0	135,500	9.3	30,198	10	6.144	
3	Remote Repeater Co-p.	.3	27,600	86	1.0	83,200	9.3	18,7149	10	6.144	
4	Terminal Site Partial	1	63,900	86	1.0	63,900	9.3	14,505	10	6.144	
5	Total		1,031,600								
6	Deduct for 96ch radio	8	9,000	(72,000)	86	1.0	(72,000)	22.7	(16,344)	10	6.144
7	Total		959,600								
8			959,600					215,508			
9	Chancel Bank Comm-Equip	4	6000	24,000	86	1.0	24,000	22.7	5,448	10	6.144
10	Chancel Units	96	260	24,960	86	1.0	24,960	22.7	5,666	10	6.144
11	Total							1,008,560	226,662		
12											
13											
14	Chancel Bank Comm-Equip	2	6000	12,000	92	.5645	6,774	22.7	2,224	10-6	1.789
15	Chancel Units	8	260	2,080	92	.5645	1,174	22.7	472	10-6	1.789
16											
17	Add to MW Repeater Equip										
18	Repeater Site Partial	1	127,600	127,800	86	1.0	127,800	22.7	29,011	10	6.144
19	Deduct for 96ch radio	2	9,000	(18,000)	86	1.0	(18,000)	22.7	(4,084)	10	6.144
20	Total										

REMARKS:

NON-STANDARD ANNUAL COST PERCENTAGES			
(1)	(2)	(3)	(4)
(5)			
TYPE OF PLANT			
C OF M			
PROPERTY TAX			
INCOME TAX			
DEPRECIATION			
MAINTENANCE			
TOTAL %			

ECONOMIC SELECTION STUDY

DESCRIPTION:

Helen - Missouri Telephone Communications Route
Microwave Radio Reporter Sites Unit Costs

PLAN 2 OF 3 SHEET 2 OF 3
PREP. BY MJ DATE 86 Thru 95
STUDY PERIOD

ITEM	QUANTITY	UNIT COST	FIRST COST	CAPITAL REQUIREMENTS		REVENUE REQUIREMENTS	
				DATE OF EXPEND.	PRESENT WORTH OF FIRST COST	ANNUAL COST	PRESENT WORTH OF ANNUAL COSTS
1	2	3	4	5	6	7	8
10							
11	Remote Repeaters						
12	Splices, Each Site	1 lot	10,000	10,000	22.7	2,270	13,947
13	Digital Microwave Radio	2	\$3,400	10,0,800	22.7	2,2,882	140,582
14	Antenna System	2	9,000	18,000	22.7	4,086	25,104
15	Battery and Power	1	5,600	5,600	22.7	1,271	7,809
16	AC Generator	1	35,000	35,000	21.7	7,595	46,664
17	Tower, 150 Ft.	1	62,000	62,000	21.7	13,454	82,661
18	Land And Site Work	1	30,000	30,000	18.0	5,400	33,178
19	Building	1	25,200	25,200	21.7	5,425	33,331
20	Total		286,400		623,383		383,281

REMARKS:

	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	MW+MUX	Towers	Buildings	Land	A.C. Gen.
C OF M	10	10	10	10	10
PROPERTY TAX	0	0	0	0	0
INCOME TAX	0	0	0	0	0
DEPRECIATION	6.7	6.7	6.7	0	6.7
MAINTENANCE	6	5	5	8	5
TOTAL \$	22.7	21.7	21.7	18.0	21.2

ECONOMIC SELECTION STUDY

DESCRIPTION:

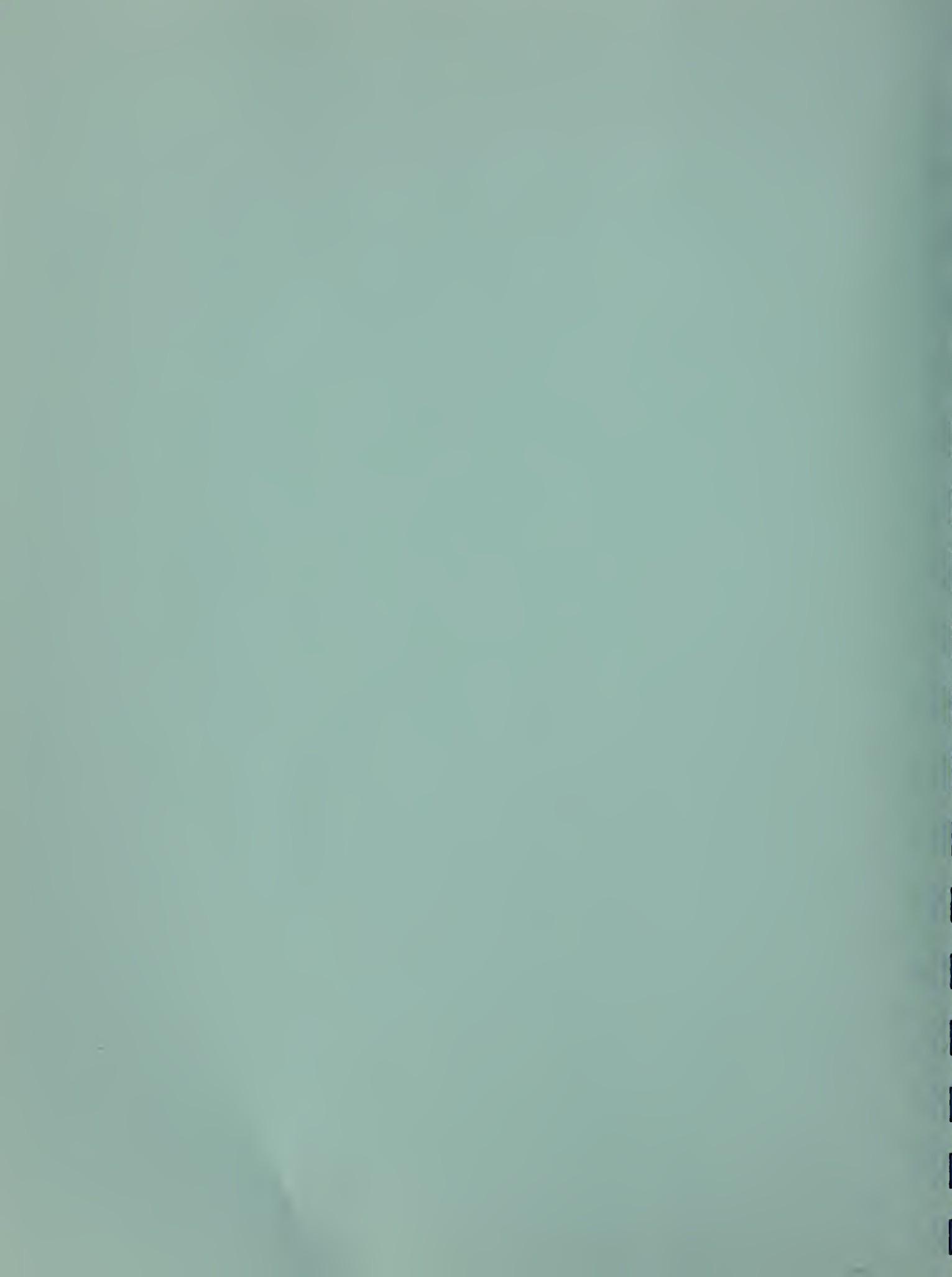
Helena - Missoula Telephone Communications Route
Microwave Radio Terminal Site Unit Costs

PLAN 2 OR 3 MEET 2 OR 3
PREP. BY M. DATE 8/6 thru 9/5

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS		REVENUE REQUIREMENTS		PRESENT WORTH OF ANNUAL COSTS
			PRESENT WORTH OF FIRST COST	ANNUAL COST	PERIOD FACTOR	AMOUNT	
1 Complete Terminal Site							
1 Digital Microwave Radio	1	\$4,900	\$4,900	1.0	22.7	1,461	10 6.144 76,567
2 Antenna System	1	9,000	9,000		22.7	2,043	12,552
3 Battery and Power	1	\$1,600	\$1,600		22.7	6,221	
4 AC Generator	1	35,000	35,000		21.7	7,595	7,809
5 Tower, Stub, 30 ft.	1	16,000	16,000		21.7	3,472	44,664
6 Site Work, Existing Bldgs.	1 Lot	\$5,000	\$5,000		21.7	1,085	21,332
7 Total					21.7		6,666
8 Spares, Each Site	1 Lot	10,000	10,000		22.7	2,270	
9 Total					22.7	1,988	13,947
10							185,537
11							
12 Partial Term. Site							
13 Digital Microwave Radio	1	\$4,900	\$4,900	1.0	22.7	1,2,462	10 6.144 76,567
14 Antenna System	1	9,000	9,000	"	22.7	2,043	12,552
15 Total					14,505		
16							89,115
17 Partial Repeater Site							
18 Digital Microwave Radio	2	\$4,900	10,900	800	1.0	22.7	
19 Antenna System	2	9,000	18,000	"	22.7		
20					127,800		
						29,011	10 6.144 178,241

NOTES:

NON-STANDARD ANNUAL COST PERCENTAGES			
TYPE OF PLANT	(1)	(2)	(3)
C OF M			(4)
PROPERTY TAX			(5)
INCOME TAX			
DEPRECIATION			
MAINTENANCE			
TOTAL			



SECTION 3

HELENA-GREAT FALLS

TELECOMMUNICATIONS ROUTE STUDY

Three plans are compared in the analysis of the Helena-Great Falls route as follows:

1. Conventional circuits as used at present
2. Microwave radio with T1 channel banks, all facilities are State owned.
The terminal at Helena and the first repeater have reduced costs
because it is assumed that they have been installed for other routes.
3. T1 circuits. The transmission medium would be owned by a common
carrier and the channel banks would be State owned.

The map illustrates the physical routing of the microwave system.

The economic selection study work sheets for each plan include the quantities
and costs of all facilities, the annual charges and the calculations.

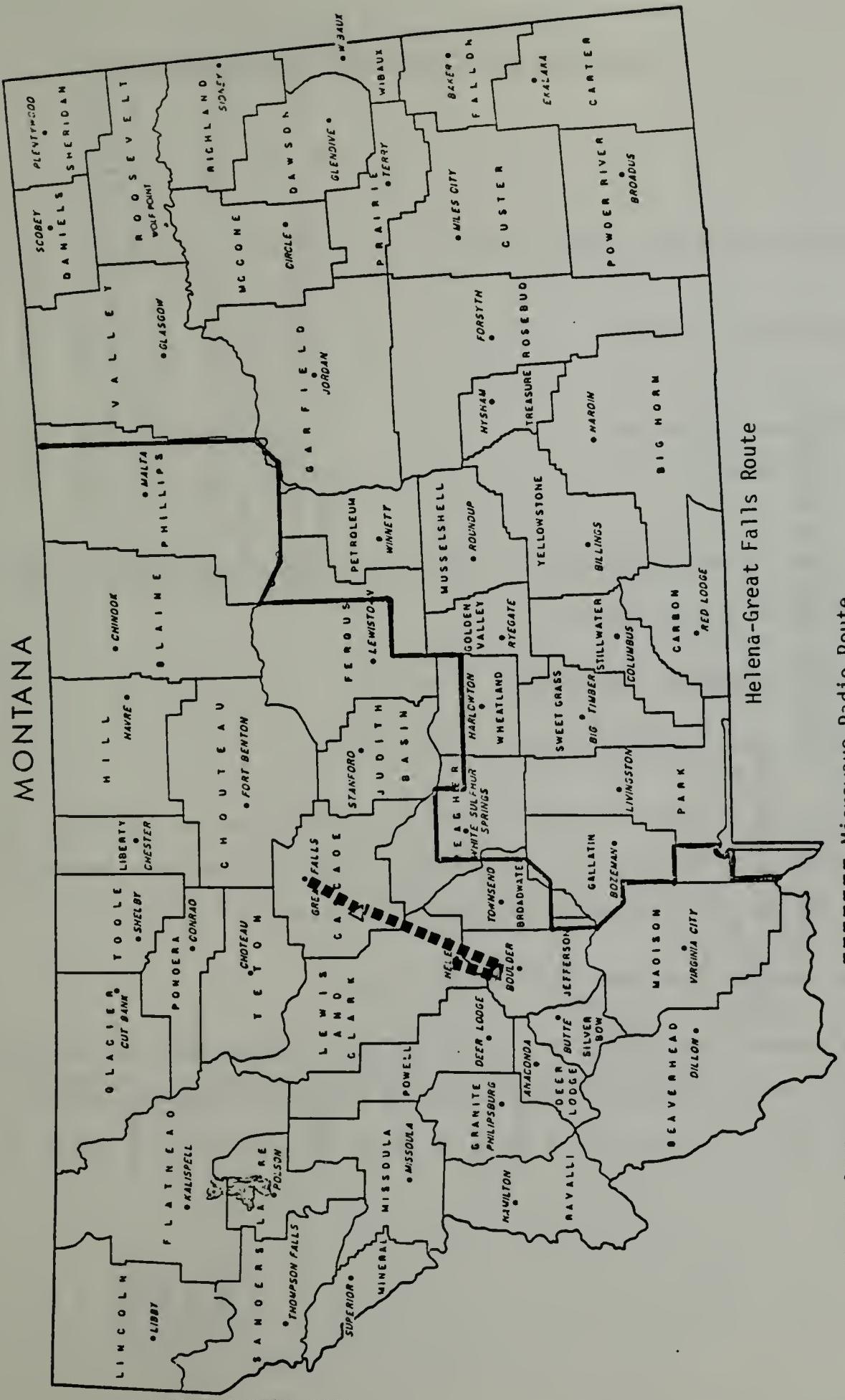
Summary of Results

Present Worth of

	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$ 681,203	Conventional circuits
Plan 2	820,450	Microwave Radio
Plan 3	482,696	T1 Circuits

The results indicate that T1 is clearly the most cost effective method of providing circuits in this route for the quantities of circuits used in the analysis. The cost relationships for 1986 are illustrated in the annual costs per circuit graph. Note also that the conventional circuits would increase in cost at a compounded rate of 7% per year, while the other methods of providing circuits would remain relatively constant.

MONTANA



Helena-Great Falls Route

■ ■ ■ ■ ■ Microwave Radio Route

• County Seat

△ Repeater

HELENA-GREAT FALLS ROUTE CIRCUIT REQUIREMENTS

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Helena-Great Falls, 20 voice, 3 data	24	25	26	27	28	29
Helena-Havre, 8 voice	8	9	9	9	10	10
Adjustment for rounding	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>1</u>
TOTAL	33	34	35	37	38	40

5% added to 1986 requirements to account for estimated overflow to discounted toll on the present system.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

The growth is less than would require a third channel bank so 36 circuits are used to represent the total. Small additions or reductions would not change the results within the acceptable level of accuracy.

The radios on this route are 96 channel capacity.

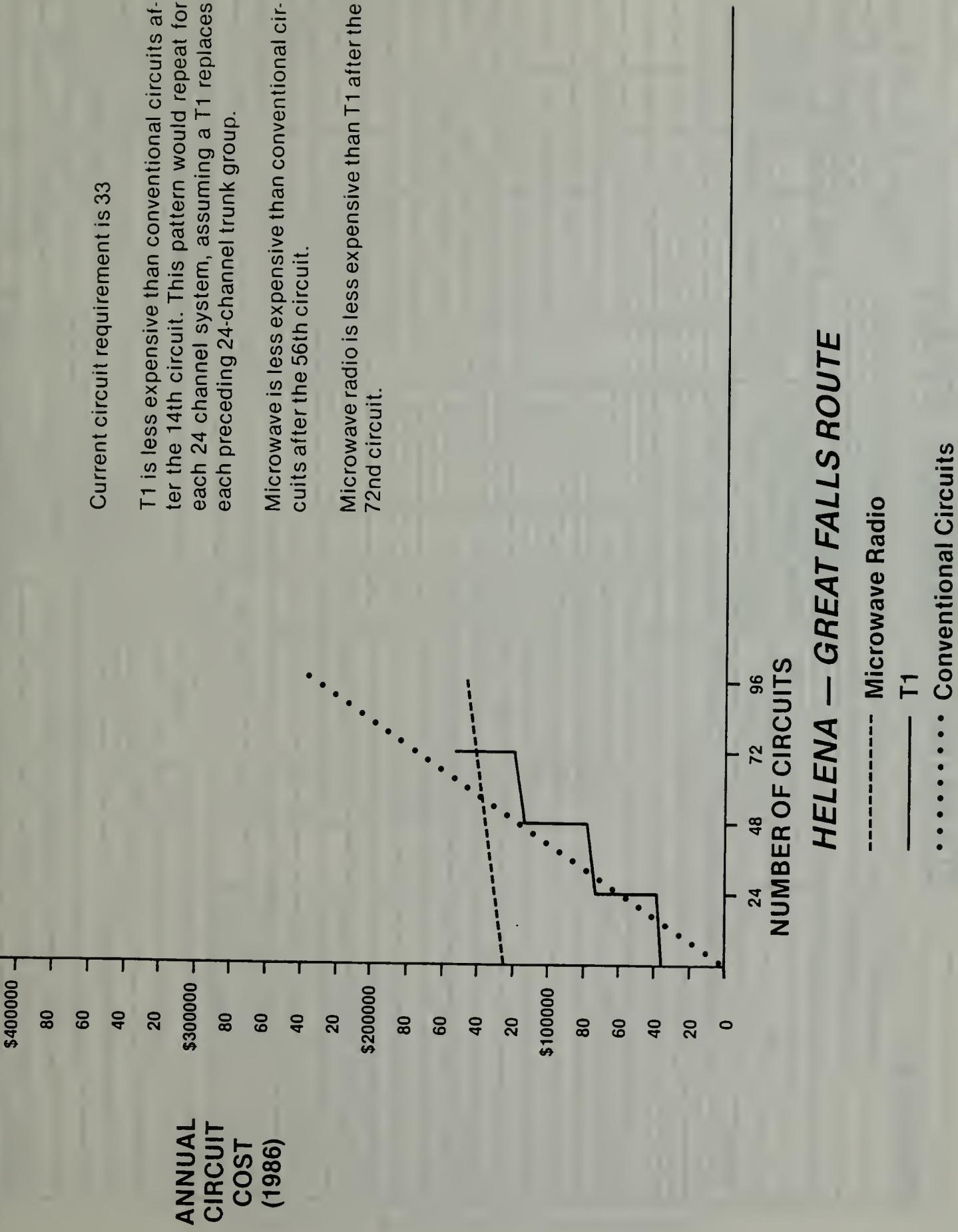
One repeater site would be in place if the Helena-Bozeman route was installed. Helena terminal and the repeater site costs reflect the equipment added for this route.

Current circuit requirement is 33

T1 is less expensive than conventional circuits after the 14th circuit. This pattern would repeat for each 24 channel system, assuming a T1 replaces each preceding 24-channel trunk group.

Microwave is less expensive than conventional circuits after the 56th circuit.

Microwave radio is less expensive than T1 after the 72nd circuit.



ECONOMIC SELECTION STUDY

DESCRIPTION:

Helenz - Great Falls Telecommunications Route
Conventional Circuits

PLAN 3 OF 3 SHEET 1 OF 1
PREP. BY M DATE 8/6/95
STUDY PERIOD 8/6 thru 9/5

ITEM	QUANTITY	UNIT COST	FIRST COST	CAPITAL REQUIREMENTS		REVENUE REQUIREMENTS		
				CONVENT. TO AMOUNT	DATE OF EXPEND.	PRES. WORTH OF FIRST COST	ANNUAL COST	PER CENT
1 Helenz - Great Falls Cnts	36	135	X 12.564	86		83,676		
2								
3								
4								
5 Ckt Cost Additions 7% /yr	36	12.95	X 12.564	87		5857		
6								
7								
8								
9								
10								
11								
12								
13								
14								
15 One time installation chg	13	517				86	1	7501
16								
17 Total								
18								
19								
20								

REMARKS:

Deducted existing circuits from one time changing quantity.

TYPE OF PLANT	(1)	(2)	(3)	(4)	(5)
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL \$					

ECONOMIC SELECTION STUDY

DESCRIPTION:

Heleno - Great Falls Telecommunications Route
Microwave Radio And T1 Channel Blocks

PAGE 2 OF 3 SHEET 1 OF 3
PREP. BY A DATE
STUDY PERIOD 86 thru 95

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS		REVENUE REQUIREMENTS		
			FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST DATE OF EXPEND.	ANNUAL COST PER CENT	PERIOD FACTOR	PRESENT WORTH OF ANNUAL COSTS
1	Microwave Radio Equip						
2	Terminal Site Complete	1	135,500	135,500	86 1.0	.3	30,198 /0 6.144 185,537
3	Remote Repeater Comp	1	286,400	286,400	86 1.0	.2	62,383 383,281
4	Terminal Site Partial	1	63,900	63,900	86 1.0	.7	14,565 89,119
5	Remote Repeater Partial	1	127,800	127,800	86 1.0	.7	22.7 178,244
6	Deduct for 96 Ch Radio	6	9000	(54,000)	86 1.0	.7	(12,258) (75,313)
7							
8							
9							
10	Channel Break Comm. Equip	4	6000	24,000	86 22.7	5.448 /0 6.144 33,473	
11	Channel Units	72	260	18,720	86 22.7	4,249 /0 6.144 26,109	
12	Total						820,450
13							
14							
15							
16							
17							
18							
19							
20							

REMARKS:

TYPE OF PLANT	NON-STANDARD ANNUAL COST PERCENTAGES				
	(1)	(2)	(3)	(4)	(5)
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helene - Great Falls Telephone Communications Route
Microwave Radio Repeater Sites

PAGE 2 OF 3 SHEET 2 OF 3
PREP. BY M DATE 95
STUDY PERIOD 86 thru 95

ITEM	QUANTITY	UNIT COST	FIRST COST	PRESENT WORTH OF FIRST COST	ANNUAL COST			REVENUE REQUIREMENTS		
					DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	AMOUNT	PERIOD FACTOR
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11	Remote Repeaters									
12	Spare, Each Site	1 lot	10000	10,000						
13	Digital Microwave Radio	2	50400	100,800						
14	Anemone System	2	9000	18,000						
15	Battery and Power	1	5500	55,000						
16	AC Generator	1	35000	35,000						
17	Tower, 150 FT.	1	62000	62,000						
18	Land And Site Work	1	30,000	30,000						
19	Building	1	25,000	25,000						
20	Total			286,400						

ADJUSTED ANNUAL COST PERCENTAGES		
TYPE OF PLANT	MW+MUX	Towers
C OF M	10	10
PROPERTY TAX	0	0
INCOME TAX	0	0
DEPRECIATION	6.7	6.7
MAINTENANCE	6	5
TOTAL %	22.7	21.7

(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	MW+MUX	Towers	Buildings	A.C. Gen.
C OF M	10	10	10	10
PROPERTY TAX	0	0	0	0
INCOME TAX	0	0	0	0
DEPRECIATION	6.7	6.7	6.7	6.7
MAINTENANCE	6	5	5	5
TOTAL %	22.7	21.7	21.7	21.7

REMARKS:

DESCRIPTION:

Heine - Great Falls Telecommunications Route

PLM 2 OF 3 SWEET 3 OF
PREP. BY M DATE —
STYLING DESIGNER 8674 C.R.

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS		REVENUE REQUIREMENTS	
			FIRST COST	PRESENT WORTH OF FIRST COST	ANNUAL COST	PRESENT WORTH OF ANNUAL COSTS
1 Complete Terminal Site.						
1 Digital Microwave Radio	1	\$4,900	\$4,900	1.0	22.7	12,462
2 Antennae System	1	9,000	9,000		22.7	2,043
3 Battery and Power	1	5,600	5,600		22.7	1,271
4 AC Generator	1	35,000	35,000		21.7	7,595
5 Tower Stand, 30 ft.	1	16,000	16,000		21.7	3,472
6 Site Work, Existing Bldg.	1 Lot	5,000	5,000		21.7	1,085
7 Total		125,500			22.7	30,198
8 Spares for Each Site	1 Lot	10,000	10,000		22.7	2,270
9 Total		135,500			22.7	32,462
10						
11						
12 Partial Terminal Site						
13 Digital Microwave Radio	1	\$4,900	\$4,900	1.0	22.7	12,462
14 Antenne System	1	9,000	9,000	"	22.7	2,043
15 Total		63,900			14,505	8,911
16 Partial Terminal Site						
17 Digital Microwave Radio	2	\$4,400	10,9,800	800	22.7	2,270
18 Antenne System	2	9,000	18,000	"	22.7	3,472
19 Total			127,800		29,011	10,6,144
20						
TOTAL						
MOL-STANDARD ANNUAL COST PERCENTAGES						
Type of Plant	(1)	(2)	(3)	(4)	(5)	
C of M						
PROPERTY TAX						
INCOME TAX						
DEPRECIATION						
MAINTENANCE						
TOTAL						

ECONOMIC SELECTION STUDY

DESCRIPTION:

Helen₂ - Great F₂/s T₁/s communication Route
 T₁ Circuits

PLAN 3 OF 3 SHEET 1 OF 1
 PREP. BY Mr. DATE
 STUDY PERIOD 86 thru 95

CAPITAL REQUIREMENTS				REVENUE REQUIREMENTS			
ITEM	QUANTITY	UNIT COST	PRES. WORTH OF FIRST COST	ANNUAL COST	PER CENT	AMOUNT	PERIOD FACTOR
							AMOUNT
1	Channel Bank Comm Equip.	4	6000	24,000	86	22.7	51448
2	Channel Units	72	260	18,720	86	22.7	41249
3							
4							
5	T ₁ Facility	2	276 X 12.564	86	68,248	10	6144
6							
7							
8							
9							
10	1 Time Charge 1st CKT.	1	2100	86	1.0		2100
11	1 Time Charge Subs CKT.	1	1700	86	1.0		1700
12							
13	Total						482,696
14							
15							
16							
17							
18							
19							
20							

REMARKS:

T₁ Costs are from common carrier bid and
 on 5 year contract.

HOL-STANDARD ANNUAL COST PERCENTAGES			
TYPE OF PLANT	(1)	(2)	(3)
C OF M	(4)	(5)	(6)
PROPERTY TAX			
INCOME TAX			
DEPRECIATION			
MAINTENANCE			
TOTAL %			





SECTION 4

BILLINGS-BOZEMAN

TELECOMMUNICATIONS ROUTE STUDY



Three plans are compared in the analysis of the Bozeman-Billings route as follows:

1. Conventional circuits as used at present
2. Microwave radio with T1 channel banks, all facilities are State owned.

The terminal at Bozeman has been reduced in cost because it is assumed that the support work had been accomplished for the Helena-Bozeman route. Livingston, Big Timber, and Columbus are repeater points and could have access to the network at a small additional expense not included in these costs. If considered desirable, this drop and insert capability should be provided when the system is first constructed.
3. T1 circuits. The transmission medium would be owned by a common carrier and the channel banks would be State owned.

The map illustrates the physical routing of the microwave system.

The economic selection study work sheets for each plan include the quantities and costs of all facilities, the annual charges and the calculations.

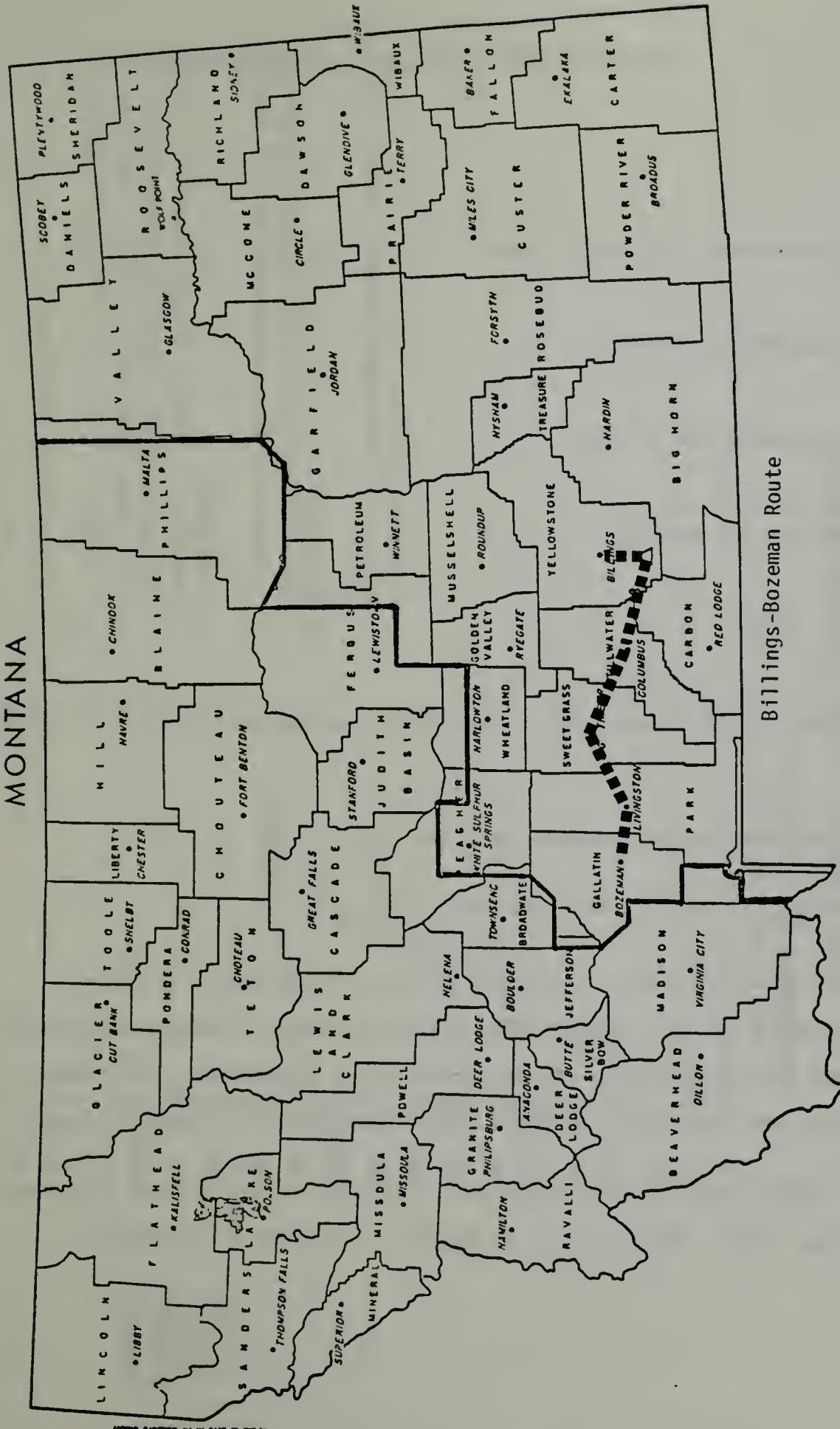
Summary of Results

Present Worth of

	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$1,155,191	Conventional circuits
Plan 2	1,382,675	Microwave Radio
Plan 3	716,157	T1 Circuits

The results indicate that T1 is clearly the most cost effective method of providing circuits in this route for the quantities of circuits used in the analysis. The cost relationships for 1986 are illustrated in the annual costs per circuit graph. Note also that the conventional circuits would increase in cost at a compounded rate of 7% per year, while the other methods of providing circuits would remain relatively constant.

MONTANA



Billings-Bozeman Route

• County Seat

Repeater

BILLINGS-BOZEMAN ROUTE CIRCUITS REQUIREMENTS

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Billings-Helena, 22 voice, 3 data	27	28	28	30	30	31
Billings-Bozeman, 6 voice	6	6	7	7	7	7
Billings-Missoula, 6 voice	6	6	7	7	7	7
Adjustment for rounding	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>	<u>2</u>
TOTAL	39	40	42	44	46	47

5% added to 1986 requirements to account for estimated overflow to discounted toll.

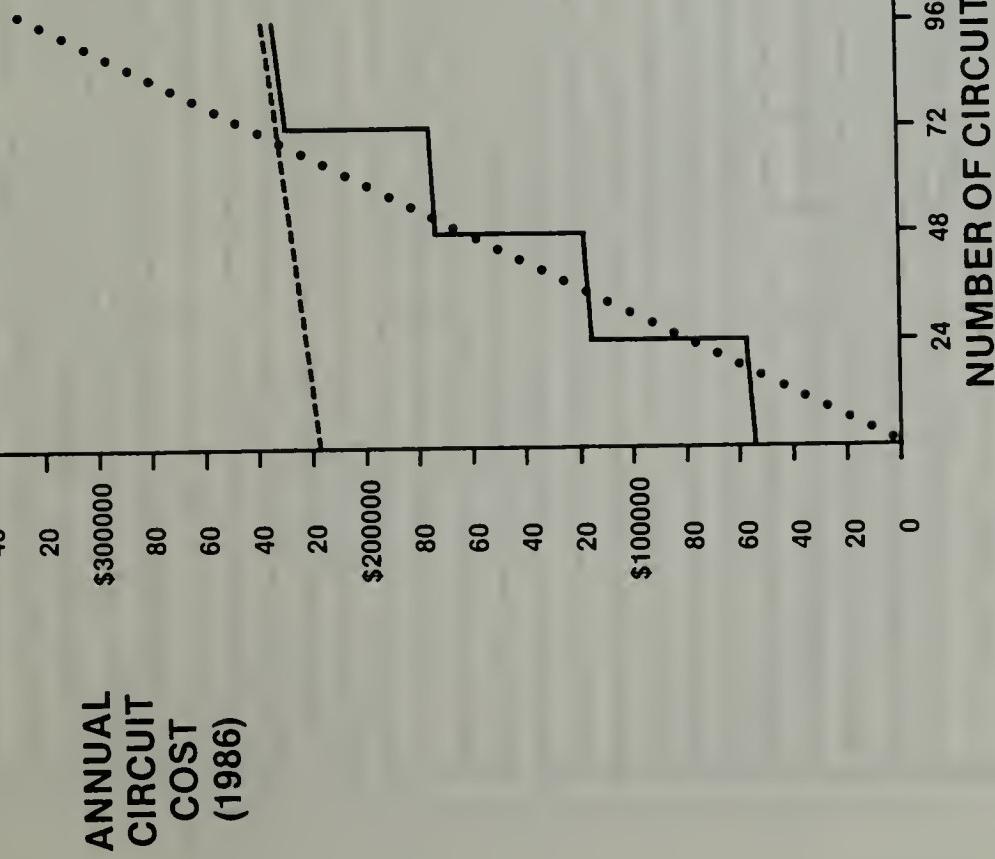
Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

As the growth is small, 42 circuits are used to represent the nominal requirement for the study period. Small additions or reductions would not change the results within the acceptable level of accuracy. The growth through the study period does not require additional T1 common equipment.

The Bozeman terminal site is assumed to have been installed for the Helena-Bozeman route. The costs for the equipment was reduced accordingly.

Current circuit requirement is 39



T1 is less expensive than conventional circuits after the 16th circuit and through the 24th. This pattern would repeat for each 24 channel system, assuming a T1 replaces each preceding 24-channel trunk group.

T1 is less expensive than microwave until the 73rd circuit. They are approximately equal through the 96th circuit.

Microwave is less expensive than conventional circuits after the 68th circuit.

BILLINGS — BOZEMAN ROUTE

..... Microwave Radio
— T1
· · · · · Conventional Circuits

ECONOMIC SELECTION STUDY

DESCRIPTION:

Billing - Bozeman Telecommunications Route
Conventional Circuits

Run # 3 of 3 Sheet 1 of 1
PREP. BY M DATE —
STUDY PERIOD 86 thru 95

CAPITAL REQUIREMENTS

ITEM	QUANTITY	UNIT COST	FIRST COST	PRESENT WORTH OF FIRST COST		ANNUAL COST		REVENUE REQUIREMENTS		PRESENT WORTH OF ANNUAL COSTS
				CONVERT TO AMOUNT Annually	DATE OF EXPEND.	PER CENT	AMOUNT	PERIOD FACTOR	AMOUNT	
1 Billing - Bozeman Cnts.	42	267	X 1/2.564	86						
2										
3										
4										
5 Cost Additions	42	18.69	X 1/2.564	87						
6		20.00		88						
7		21.40		89						
8		22.90		90						
9		24.50		91						
10		26.21		92						
11		28.05		93						
12		30.01		94						
13		32.11		95						
14										
15										
16 One Time Installation Ctg	36	577		96	1.0					
17										
18 Total										
19										
20										

REMARKS:

	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL \$					

卷之三

Billings - Bozeman Telecommunications Route
Microwave Radio And T1 Channel Banks

DESCRIPTION

PLAN 2 OF 3 SHEET 1 OF 1
 PREP. BY Am DATE
 STUDY PERIOD 86 th - 95

NON-STANDARD ANNUAL COST PERCENTAGES			
TYPE OF PLANT	C O R R	PROPERTY TAX	INCOME TAX
(1)	(2)	(3)	(4)
MANUFACTURE			
DEPARTMENTAL			
SELLER			

卷之三

ECONOMIC SELECTION STUDY

DESCRIPTION:

Billings - Boggess Telephone Communications
Microwave Radio Repeater Sites

PLAN 2 OR 3 SHEET 2 OF 3
PREP. BY M. DATE STUDY PERIOD 86 from 95

ITEM	QUANTITY	UNIT COST	FIRST COST		PRESENT WORTH OF FIRST COST		ANNUAL COST		REVENUE REQUIREMENTS		PRESENT WORTH OF ANNUAL COSTS
			AMOUNT	DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	AMOUNT	PERIOD FACTOR	AMOUNT	
1 County Seat Repeater											
2 Digital Microwave Radio	2	\$50,400	100,800	86	1.0	22.7	22.882	10	6.144	140,587	
3 Antenna System	2	9,000	18,000			22.7	40.86			25,104	
4 Battery and Power	1	5,600	5,600			22.7	1.271			7,809	
5 AC Generator	1	35,000	35,000			21.7	75.95			46,664	
6 Tower, Stub, 30 Ft.	1	16,000	16,000			21.7	34.72			21,332	
7 Site Work, Existing Buildings	1 Lot	5,000	5,000			21.7	10.85			5,666	
8 Total		180,400								248,162	
9 Spaces, Each Site	1 Lot	10,000	10,000			22.7	22.70			13,947	
10 Total		190,400								262,109	
11 Remote Repeaters											
12 Spares, Each Site	1 Lot	10,000	10,000			22.7	2.270			13,947	
13 Digital Microwave Radio	2	\$3400	100,800			22.7	22.882			140,587	
14 Antenna System	2	9,000	18,000			22.7	4.086			25,104	
15 Battery and Power	1	5,600	5,600			22.7	1.271			7,809	
16 AC Generator	1	35,000	35,000			21.7	75.95			46,664	
17 Tower, 150 Ft.	1	62,000	62,000			21.7	13.454			82,661	
18 Land And Site Work	1	30,000	30,000			21.7	8.000			33,178	
19 Building	1	25,000	25,000			21.7	5.425			33,331	
20 Total		286,400								383,281	

REMARKS:

(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	MW+MUX	Towers	Buildings	Land
C OF M	10	10	10	10
PROPERTY TAX	0	0	0	0
INCOME TAX	0	0	0	0
DEPRECIATION	6.7	6.7	0	6.7
MAINTENANCE	6	5	8	5
TOTAL \$	22.7	21.7	21.7	21.7

NON-STANDARD ANNUAL COST PERCENTAGES				
TYPE OF PLANT	MW+MUX	Towers	Buildings	Land
C OF M	10	10	10	10
PROPERTY TAX	0	0	0	0
INCOME TAX	0	0	0	0
DEPRECIATION	6.7	6.7	0	6.7
MAINTENANCE	6	5	8	5
TOTAL \$	22.7	21.7	21.7	21.7

ECONOMIC SECTION STAFF

DESCRIPTION:

Billings - Bozeman Telecommunications Route
Microwave Radio Terminal Site Unit Costs

PLAN 2 OF 3 SHEET 3 OF
PREP. BY M. DATE
STUDY PERIOD 86 Mon 95

二三

TYPE OF PROPERTY	NON-STANDARD ANNUAL COST PERCENTAGES		
	(1)	(2)	(3)
C OF M	(4)	(5)	(6)
PROPERTY TAX			
INCOME TAX			
DEPRECIATION			
M A I N T E N A N C E			
T O T A L :			

ECONOMIC SELECTION STUDY

DESCRIPTION: Billings - Bozeman
T1 Circuits

Plan 3 of 3 Sheet 1
PREP. BY _____ DATE _____

STUDY PERIOD

CAPITAL REQUIREMENTS

ITEM	QUANTITY	UNIT COST	FIRST COST	PRESENT WORTH OF FIRST COST		ANNUAL COST	REVENUE REQUIREMENTS		PRESENT WORTH OF ANNUAL COSTS
				AMOUNT	DATE OF EXPEND.		FACTOR	AMOUNT	
1 Channel Bank & Ch. Equip	4/84 6000 /260	45,840	86	1.0	45,840	22.7	10,406	10	6.144 648,425
2									
3									
4									
5 T1 Facility	2	4200	X 12.564						
6									
7									
8 Line time Charge 1ST CKT	1	2100	86	1.0					
9 " " Subsequent	1	1700	86	1.0					
10									
11									
12 Total									
13									
14									
15									
16									
17									
18									
19									
20									

REMARKS:

T1 Costs are for 5 year contract

NON-STANDARD	ANNUAL	COST PERCENTAGES
(1)	(2)	(5)

TYPE OF PLANT	(1)
C OF M	(3)
PROPERTY TAX	(4)
INCOME TAX	(5)
DEPRECIATION	
MAINTENANCE	
TOTAL \$	

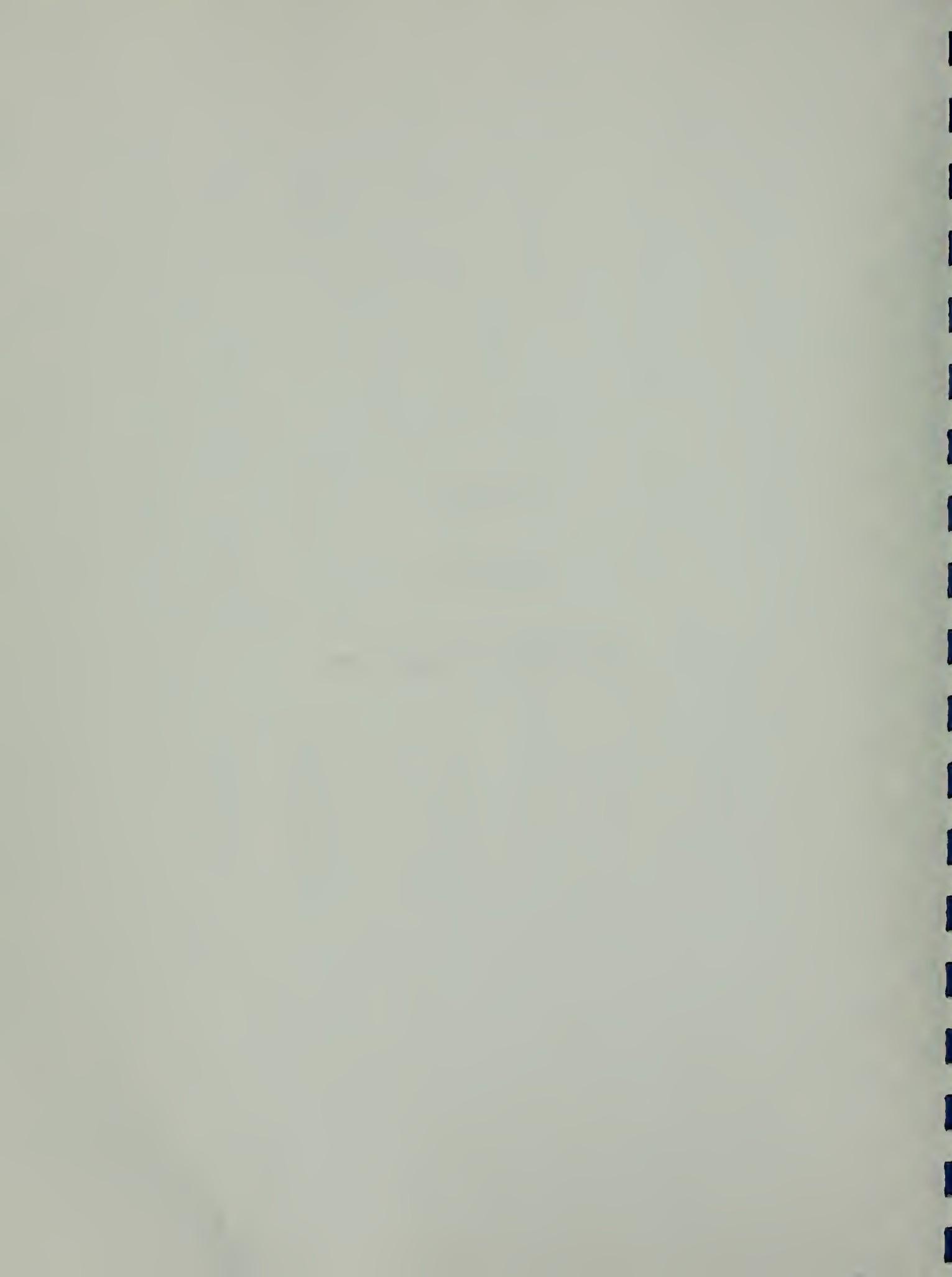




SECTION 5

HELENA-BUTTE

TELECOMMUNICATIONS ROUTE STUDY



Three plans are compared in the analysis of the Helena-Butte route as follows:

1. Conventional circuits as used at present
2. Microwave radio with T1 channel banks, all facilities are State owned.
The microwave radio route is assumed to be in place from Helena to the third repeater for the Helena-Bozeman route. A cost is added for the drop and insert capability at the third repeater and a new radio and antenna system is installed there for the new route extending west to Butte. The initial Helena-Bozeman radios have ample capacity to add these requirements. A complete repeater site is required before Butte and a complete terminal site is required at Butte. Channel banks are installed at Helena and at Butte.
3. T1 circuits. The transmission medium would be owned by a common carrier and the channel banks would be State owned.

The map illustrates the physical routing of the microwave system.

The economic selection study work sheets for each plan include the quantities and costs for all facilities, the annual charges and the calculations.

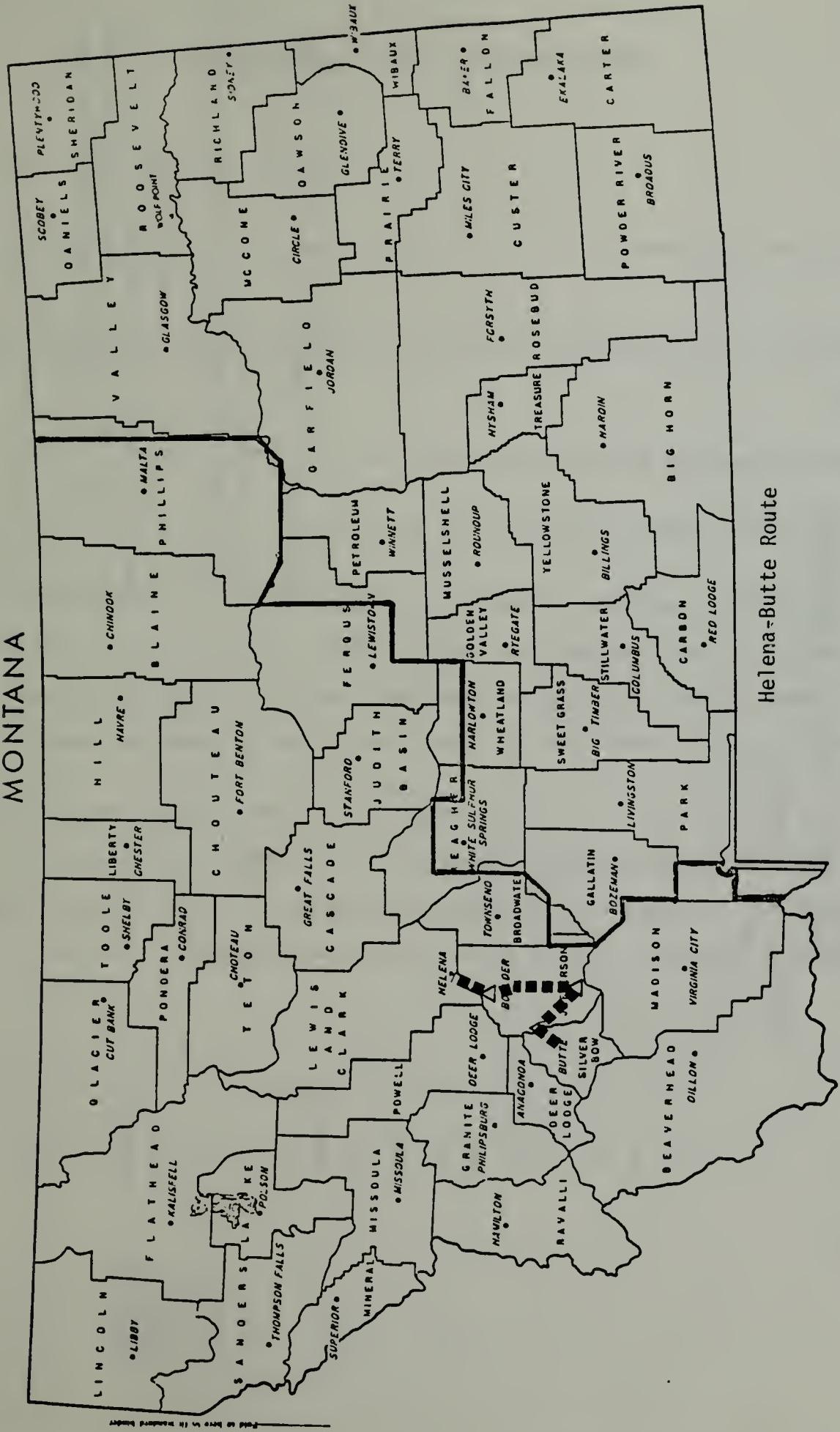
Summary of Results

Present Worth of

	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$ 315,736	Conventional circuits
Plan 2	652,9475	Microwave Radio
Plan 3	187,526	T1 Circuits

The results indicate that T1 is clearly more economical for circuit requirements greater than 16 on the route at the present rates. T1 is significantly more cost effective than conventional circuits over the life of the study, but savings are not projected in the initial year. As these results are borderline but not conclusive at this time, it is recommended that the route be included in the request for proposal for T1 circuits. The results of the proposal could determine the decision to continue with conventional circuits or change to T1. Any increase in conventional circuit costs would tend to prove in T1 as would a requirement for 56 Kbps data and an increase in the circuit requirements.

MONTANA



• County Seat

△ Repeater

■■■■■ Microwave Radio Route

Helena-Butte Route

HELENA-BUTTE ROUTE CIRCUITS REQUIREMENTS

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Helena-Butte, 15 voice	19	20	21	21	22	23

5% added to 1986 requirements to account for estimated overflow to discounted toll.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

As the circuit requirement is small, 21 circuits are used to represent the nominal requirement for the study period. Small additions or reductions would not change the results within the acceptable level of accuracy. The growth through the study period does not require additional T1 common equipment.

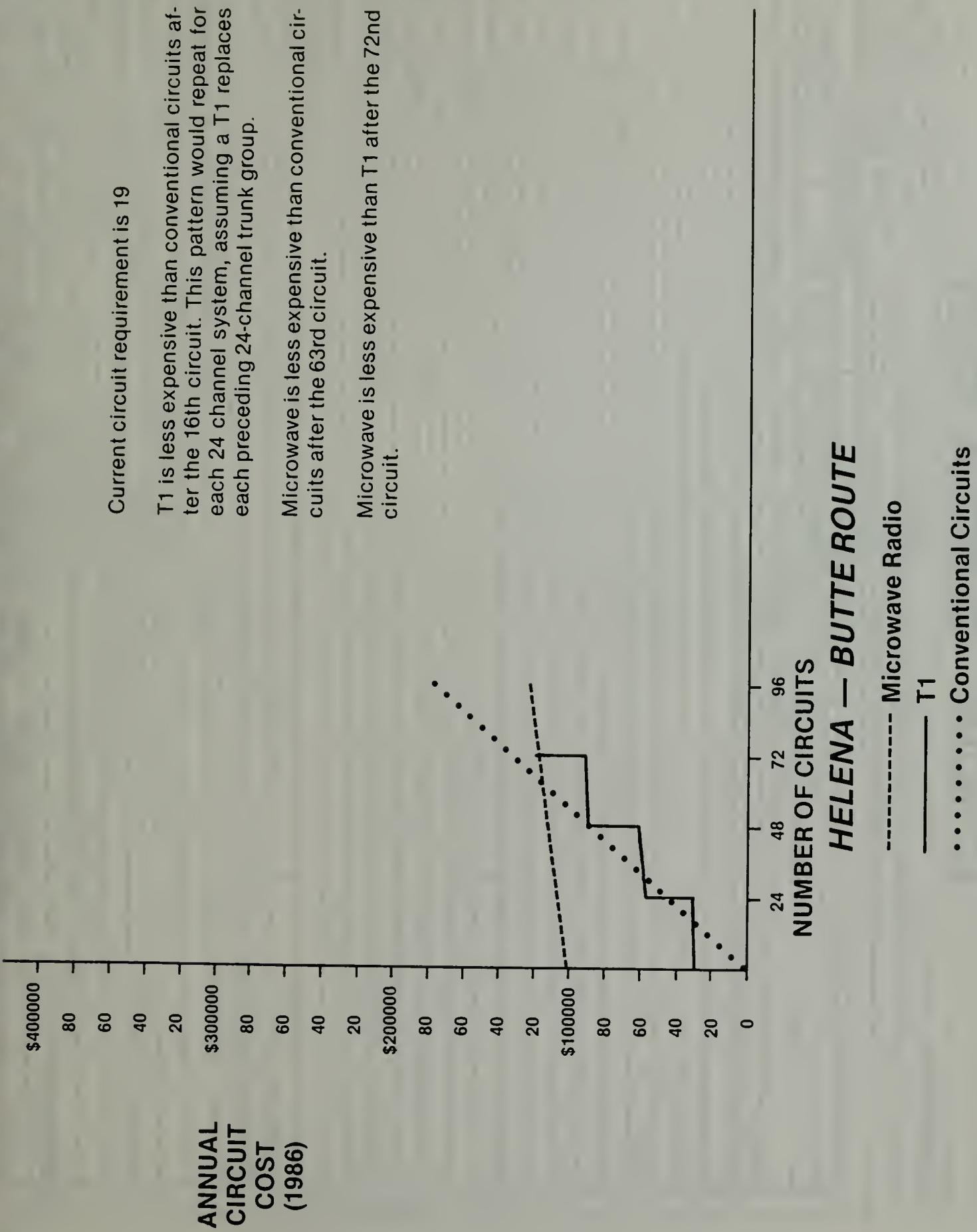
All but one repeater and the Butte terminal are assumed to have been installed for the Helena-Bozeman route. The costs for the equipment was reduced accordingly. A cost was added to one of the repeaters for the drop and insert capability required to add the leg to Butte from the repeater. See map.

Current circuit requirement is 19

T1 is less expensive than conventional circuits after the 16th circuit. This pattern would repeat for each 24 channel system, assuming a T1 replaces each preceding 24-channel trunk group.

Microwave is less expensive than conventional circuits after the 63rd circuit.

Microwave is less expensive than T1 after the 72nd circuit.



ECONOMIC SELECTION STUDY

DESCRIPTION:

Hellen - Battle Telecommunications Route
Conventional Circuits

PLN / OF 3 SWEET / OF 1
PREP. BY _____ DATE _____
STUDY PERIOD 1956 - 95

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS			REVENUE REQUIREMENTS			PRESENT WORTH OF ANNUAL COSTS		
			FIRST COST CONV'D TO ANNUAL EXPEND.	DATE OF EXPEND.	PRES. WORTH OF FIRST COST AMOUNT	PER CENT	AMOUNT	PERIOD	FACTOR	AMOUNT	
1 Hellen - Battle Ckts	21	147	X 12.564	86			38,785	10	.6144	238,295	
2											
3											
4											
5 Ckt. cost Additions	21	10.29	X 12.564	87			2,715	10-1	5.235	14,213	
6		11.01		88			2,905	10-2	4.405	12,805	
7		11.78		89			3,108	10-3	3.657	11,366	
8		12.61		90			3,327	10-4	2.974	9,894	
9		13.48		91			3,557	10-5	2.353	8,370	
10		14.33		92			3,807	10-6	1.789	6,811	
11		15.14		93			4,074	10-7	1.226	5,198	
12		16.52		94			4,359	10-8	.809	3,526	
13		17.68		95			4,665	10-9	.385	1,796	
14											
15 Once time installation Chg	6	577		86	1.0						
16											
17 Total											
18											
19											
20											

REMARKS:

NON-STANDARD ANNUAL COST PERCENTAGES			
TYPE OF PLANT	(1)	(2)	(3)
C OF M	(4)	(5)	(5)
PROPERTY TAX			
INCOME TAX			
DEPRECIATION			
MAINTENANCE			
TOTAL %			

ECONOMIC SELECTION STUDY

DESCRIPTION:

Holman - Butte Telephone Communications Route
Microwave Radio And T1 Channel Banks

PLN 2 OF 3 SHEET 1 OF 3
PREP. BY DATE
STUDY PERIOD

ITEM	QUANTITY	UNIT	FIRST COST	CAPITAL REQUIREMENTS			REVENUE REQUIREMENTS				
				AMOUNT	DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	ANNUAL COST	PERIOD FACTOR	PRESENT WORTH OF ANNUAL COSTS
1 Channel Bank Equip	2	COOO	\$2,000	86	1.0						
2 Channel Units	12	XO	10,920	86	1.0						
3 Total			22,920								
4											
5 Microwave Radio Equip											
6 Terminal Site Complete	1		\$35,500	86	1.0						
7 Remote Repeater	1		\$85,400	86	1.0						
8 Repeater Partial	1		73,400	86	1.0						
9 Total			495,300								
10											
11 Deduct for 96 channels	4		9000 (\$36,000)	86	1.0						
12											
13 Grand Total			482,220								
14											
15											
16											
17											
18											
19											
20											

REMARKS:

	NON-STANDARD ANNUAL COST PERCENTAGES		
	(1)	(2)	(3)
TYPE OF PLANT			
C OF M			
PROPERTY TAX			
INCOME TAX			
DEPRECIATION			
MAINTENANCE			
TOTAL %			

ECONOMIC SELECTION STUDY

DESCRIPTION:

Helenz - Butte Telecommunications Route
Microwave Radio Site Unit Costs

PLN 2 OF 3 SHEET 2 OF 3
PREP. BY _____ DATE _____
STUDY PERIOD _____

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS		REVENUE REQUIREMENTS		
			FIRST COST	PRES. WORTH OF FIRST COST DATE OF EXPEND. FACTOR	ANNUAL COST	PER CENT	AMOUNT
1 Terminal Site				86 1.0			10 6.144
2 Digital Microwave Radio	1	54,900			22.7 12.462		75,567
3 Antenna System	1	9,000			22.7 2.043		12,552
4 Battery and Power	1	5,600			22.7 1.271		7,809
5 AC Generator	1	35,000			21.7 7.595		46,644
6 Tower Stub, 30 FT.	1	16,000			21.7 3.472		21,332
7 Site Work, Existing Bldgs.	1. Lot + 5,000				21.7 1.085		6,666
8 Spares, Each Site	1 Lot + 10,000				22.7 2.270		13,947
9 Total		135,500			30,198		185,537
10							,
11 Remote Repeaters				86 1.0			,
12 Spares, Each Site	1 Lot	10,000	10,000		22.7 2.270		13,947
13 Digital Microwave Radio	2	50,400	100,800		22.7 2.2882		140,587
14 Antenna System	2	9,000	18,000		22.7 9,086		25,104
15 Battery and Power	1	5,600	5,600		22.7 1.271		7,809
16 AC Generator	1	35,000	35,000		21.7 7.595		46,664
17 Tower, 150 FT.	1	62,000	62,000		21.7 1.3,454		82,661
18 Land And Site Work	1	30,000	30,000		18.0 5,400		33,178
19 Building	1	25,200	25,200		21.7 5,425		33,381
20 Total			286,400		62,383		383,281

REMARKS:

NON-STANDARD ANNUAL COST PERCENTAGES			
(1)	(2)	(3)	(4)
TYPE OF PLANT	MW+MWX	Towers	Buildings Land A.C. Gen.
C OF M	10	10	10 10
PROPERTY TAX	0	0	0 0
INCOME TAX	0	0	0 0
DEPRECIATION	6.7	6.7	6.7 0
MAINTENANCE	6	5	5 8
TOTAL %	22.7	21.7	21.7 18.0

ECONOMIC SELECTION STUDY

DESCRIPTION:

Helene - Butte Telecommunications Route
Microwave Radio Site Unit Costs

PLN 2 OF 3 STREET 2 OF 3
PREP. BY _____ DATE _____
STUDY PERIOD _____

ITEM	QUANTITY	UNIT COST	FIRST COST	PRESENT WORTH OF FIRST COST		ANNUAL COST	REVENUE REQUIREMENTS		PRESENT WORTH OF ANNUAL COSTS
				AMOUNT	DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	
1 Partial Repeater Site				86	1.0				
2 Drop & Insert Capability in/out	1	14,000	14,000			22.7	3178		
3 Digital Microwave Radio	1	50,400	50,400			22.7	11491		
4 Antenne System	1	9000	9,000			22.7	2043		
5			73,400						
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

REMARKS:

	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL \$					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helene - Butte Telephone Communications Route
T1 Circuits

PLN 3 OF 3 SHEET 1 OF 1
PREP. BY _____ DATE _____
STUDY PERIOD _____

ITEM	QUANTITY	UNIT	FIRST COST	CAPITAL REQUIREMENTS		REVENUE REQUIREMENTS		PRESENT WORTH OF ANNUAL COSTS
				AMOUNT	DATE OF EXPEND.	AMOUNT	PER CENT	
1 Channel Bank Equip	2	6000	12,000	86	1.0			
2 Channel Units	42	260	10,920	86	1.0			
3			22,920					
4								
5 Monthly Factor To Change Costs To Annual								
6 T1 Facility	1	2840	X /2.564	86		35,682	10	6,144
7 30% discount for 5 year contract						(10,705)		(15,769)
8								
9 Time Charge	1	2100		86	1.0			
10								
11								
12 Total						30,180		187,524
13								
14								
15								
16								
17								
18								
19								
20								

REMARKS: T1 costs for facility based on
5 year contract

TYPE OF PLANT	NON-STANDARD ANNUAL COST PERCENTAGES		
	(1)	(2)	(3)
C of M			
PROPERTY TAX			
INCOME TAX			
DEPRECIATION			
MAINTENANCE			
TOTAL %			





SECTION 6

HELENA-WARM SPRINGS

HELENA-DEER LODGE

TELECOMMUNICATIONS ROUTE STUDY



Helena-Warm Springs

Inspection of the Helena-Warm Springs route circuit costs reveals that the conventional circuits are priced the same as Helena-Butte circuits. The T1 circuits are slightly more expensive. The microwave route costs would be virtually the same, except for fewer channel units. This means that the cost relationship developed in the study are essentially the same for Helena-Butte and Helena-Warm Springs. Conventional circuits are more economical until the circuit requirement exceeds 16. Combining the Warm Springs and Butte circuits into a large total requirement would not be advantageous because of the significant cost to carry the circuits between Warm Springs and Butte. Combining them on microwave radio would not make the microwave radio plan cost effective because the requirements would still be lower than the prove-in point for microwave. That point would become higher in number of circuits as a result of the cost of the additional equipment required at the last repeater and the added Warm Springs terminal.

Helena-Deer Lodge

Two plans are compared in the analysis of the Helena-Deer Lodge route: conventional circuits and T1 circuits. Microwave radio is not cost effective for a cross section with circuit requirements of the size encountered on this route.

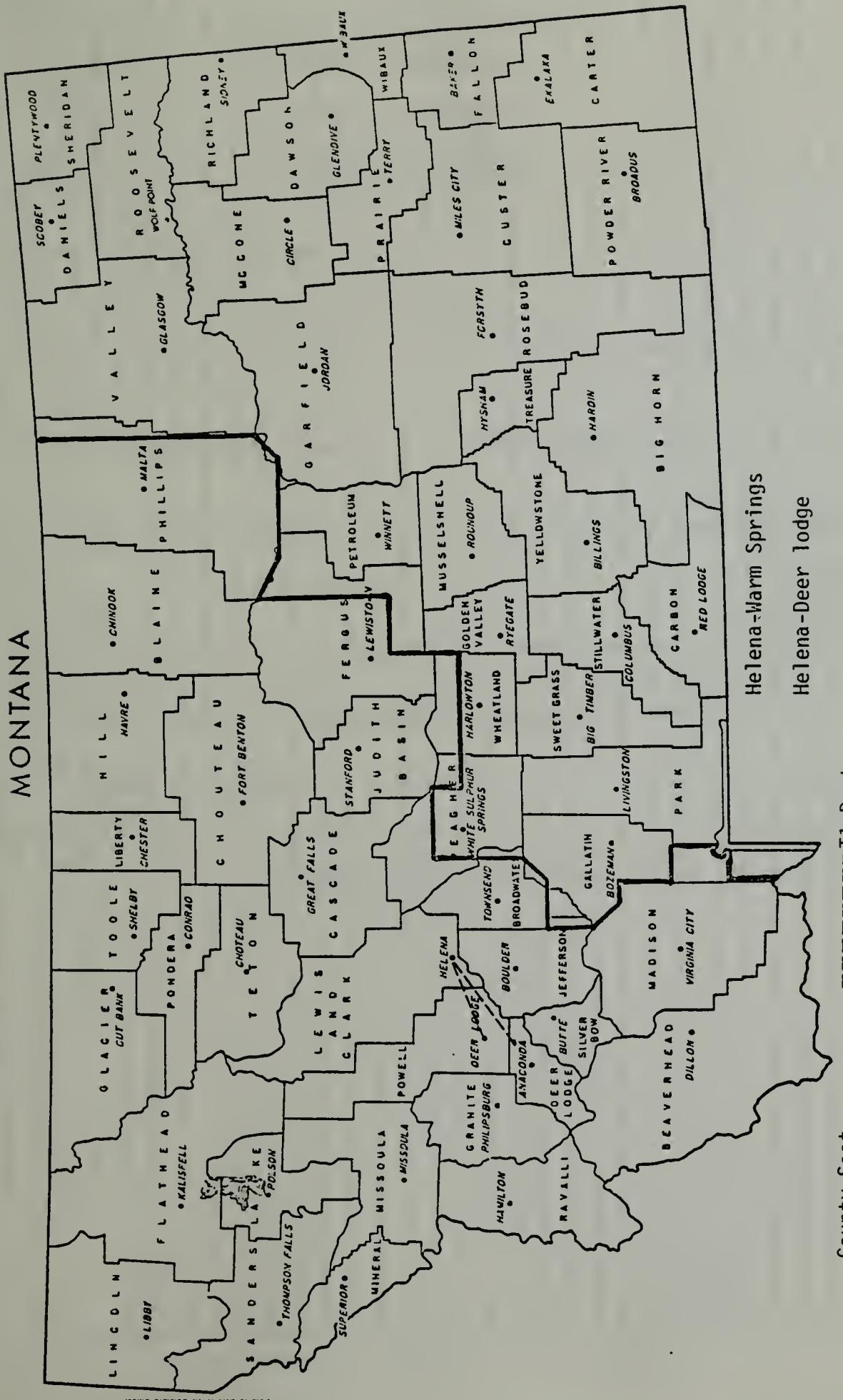
Summary of Results

Present Worth of

	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$ 131,658	Conventional circuits
Plan 2	162,258	T1 Circuits

The results indicate that conventional circuits are more cost effective than T1 circuits at the present rates and circuit requirements. As the circuit requirement is lower than the economical minimum for T1 or microwave radio, it is recommended that conventional circuits be retained. If a significant change in circuit costs or the number of circuits required occurs, this route should be re-examined. A requirement for 56 Kbps data would also be cause for re-examining the route. T1 would be more economical than conventional circuits after the 16th circuit.

MONTANA



Helena-Warm Springs

Helena-Deer lodge

County Seat

T1 Route

HELENA-WARM SPRINGS

HELENA-DEER LODGE

CIRCUIT REQUIREMENTS

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Helena-Warm Springs, 10 voice	11	11	12	12	13	13
Helena-Deer Lodge, 7 voice, 1 data	9	9	9	10	10	11

5% added to 1986 requirements to account for estimated overflow to discounted toll.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

Since growth is small, 12 circuits are used to represent the nominal requirement for the study period for Warm Springs, and 10 circuits are used to represent the nominal requirements for Deer Lodge.

ECONOMIC SELECTION STUDY

DESCRIPTION:

Halone - Deer Lodge Telecommunications Route
Conventional Circuits,

PLAN / OF 2 SHEET / OF /
PREP. BY _____ DATE _____
STUDY PERIOD _____

ITEM	QUANTITY	UNIT	FIRST COST Cost To Amount	CAPITAL REQUIREMENTS		REVENUE REQUIREMENTS			PRESENT WORTH OF ANNUAL COSTS AMOUNT
				DATE OF EXPEND.	FACTOR	PER CENT	AMOUNT	PERIOD FACTOR	
1. Helens - Deer Lodge	10	Ckt's	X 12.564	86			16,308	1.0	6.144
2									99,582
3									
4									
5. Cost Additions	10		X 12.564	87			1135	10-1	5.235
6									5944
7									
8									
9									
10									
11									
12									
13									
14									
15. O.C-T. Instal. Ckt's.	2		577						
16									
17									
18									
19									
20									

REMARKS:

NON-STANDARD ANNUAL COST PERCENTAGES				
	(1)	(2)	(3)	(4)
TYPE OF PLANT				(5)
C OF M				
PROPERTY TAX				
INCOME TAX				
DEPRECIATION				
MAINTENANCE				
TOTAL \$				

ECONOMIC SELECTION STUDY

DESCRIPTION:

Helenz - Deer Lodge Telecommunications Route
T1 Circuits

PLAN 2 OF 2 SHEET 1 OF 1
PREP. BY _____ DATE _____
STUDY PERIOD _____

ITEM	QUANTITY	UNIT COST	PRESENT WORTH OF FIRST COST	ANNUAL COST			REVENUE REQUIREMENTS		
				DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	AMOUNT	PERIOD FACTOR
1 Channel Bank Equip.	2	\$6000	-\$12,000		86	1.0			
2 Channel Units	20	\$260	-\$5,200		86	1.0			
3									
4									
5 Monthly Factor To Convert Ann. Charge									
6 T1 Facility	1	\$2520	X 12.564				31.661	10	6.144 194,527
7 30% discount for 5 year contract							(9,498)		(58,358)
8									
9 1 Time Charge	1	\$100	-\$86		86	1.0			
10									
11									
12 Total							26,067		162,258
13									
14									
15									
16									
17									
18									
19									
20									

REMARKS:

NON-STANDARD ANNUAL COST PERCENTAGES				
(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT				
C OF M				
PROPERTY TAX				
INCOME TAX				
DEPRECIATION				
MAINTENANCE				
TOTAL \$				





SECTION 7

MISSOULA-KALISPELL

TELECOMMUNICATIONS ROUTE STUDY

Two plans are compared in the analysis of the Missoula-Kalispell route: conventional circuits and T1 circuits. Microwave radio is not cost effective for the number of circuits and the route miles involved.

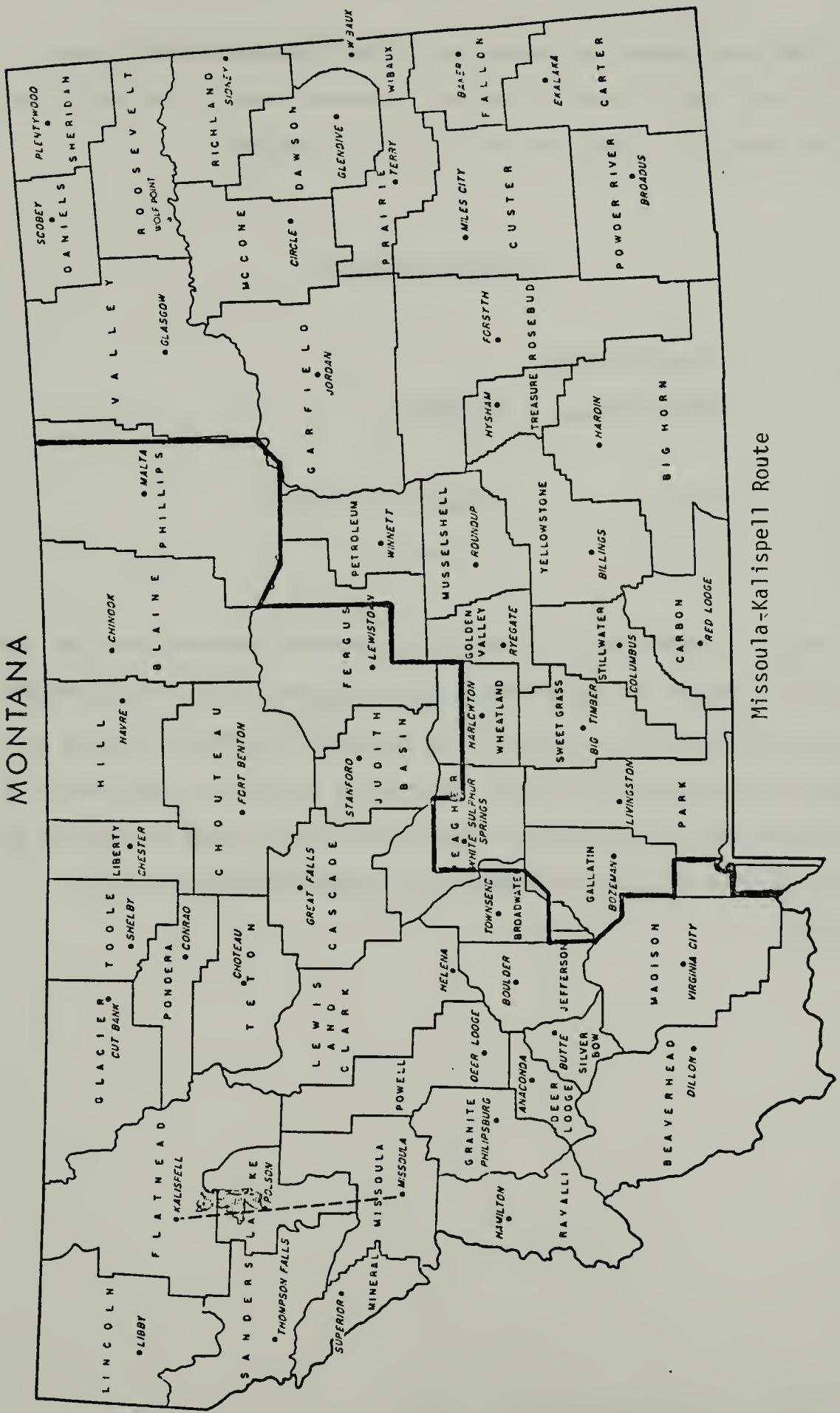
Summary of Results

Present Worth of

	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$ 333,459	Conventional circuits
Plan 2	284,761	T1 Circuits

The results indicate that T1 circuits are more cost effective over the life of the plan. However, as the present circuit requirement has not reached the break-even point of 17 circuits, no action should be taken at present to change from conventional circuits. An overall increase in requirements, a requirement for 56 Kbps data circuits or an increase in the per-circuit costs of conventional circuits would warrant a re-examination of the route economics.

MONTANA



Missoula-Kalispell Route

- County Seat

T1 Route

MISSOULA-KALISPELL ROUTE CIRCUITS REQUIREMENTS

86 88 90 92 94 96

Missoula-Kalispell, 12 voice, 1 data 14 15 15 16 17 17

5% added to 1986 requirements to account for estimated overflow to discounted toll on the present system.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per annum.

15 circuits are used to represent the total during the study period.

\$400000
80
60
40
20

ANNUAL
CIRCUIT
COST
(1986)

\$300000
80
60
40
20

\$200000

80
60
40
20

80
60
40
20

\$100000

80
60
40
20

24 48 72 96
NUMBER OF CIRCUITS

MISSOULA - KALISPELL ROUTE

— T1 Circuits

..... Conventional Circuits

Current circuit requirement is 14

T1 is less expensive than conventional circuits after the 16th circuit. This pattern would repeat for each 24 channel system, assuming a T1 replaces each 24-channel trunk group.

ECONOMIC SELECTION STUDY

DESCRIPTION: Missoola - Kellogg Telecommunications Route
Conventional Circuits

PLAN OF SWEET OF
PREP. BY DATE
STUDY PERIOD

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS		REVENUE REQUIREMENTS		PRESENT WORTH OF ANNUAL COSTS	
			FIRST COST CONTRACT AMOUNT Annually	PRESENT WORTH OF FIRST COST DATE OF EXPEND.	ANNUAL COST	PER CENT	PERIOD FACTOR	AMOUNT
1 Mission - Kalispell Ckts	1.5	219	X 12,564	86			41.273	/0
2								6.144
3								253,580
4								
5 Ckt Cost Additions	1.5	15.33	X 12.564	87		28.69	10-1	5.235
6		16.40		88		30.91	10-2	4.408
7		17.55		89		33.07	10-3	3.657
8		18.78		90		35.39	10-4	2.974
9		20.09		91		37.86	10-5	2.353
10		21.50		92		40.52	10-6	1.784
11		23.01		93		43.36	10-7	1.276
12		24.62		94		46.40	10-8	.809
13		26.34		95		49.64	10-9	.385
14								1.911
15 One-Time Installations Ckgs	2	577		86	1.0			1,154
16								
17								
18								333,469
19								
20								
REMARKS: _____								
NON-STANDARD ANNUAL COST PERCENTAGES								
(1)		(2)		(3)		(4)		(5)
TYPE OF PLANT								
C of M								
PROPERTY TAX								
INCOME TAX								
DEPRECIATION								
MAINTENANCE								
TOTAL \$								





SECTION 8

BILLINGS-MILES CITY

TELECOMMUNICATIONS ROUTE STUDY



The Billings-Miles City circuits are priced approximately the same per mile as the Missoula Kalispell circuits as follows:

	5 year	
	<u>T1</u>	<u>Conventional</u>
Missoula-Kalispell	\$34.33/month/mile	\$1.60/month/mile
Billings-Miles City	\$34.45/month/mile	\$1.60/month/mile

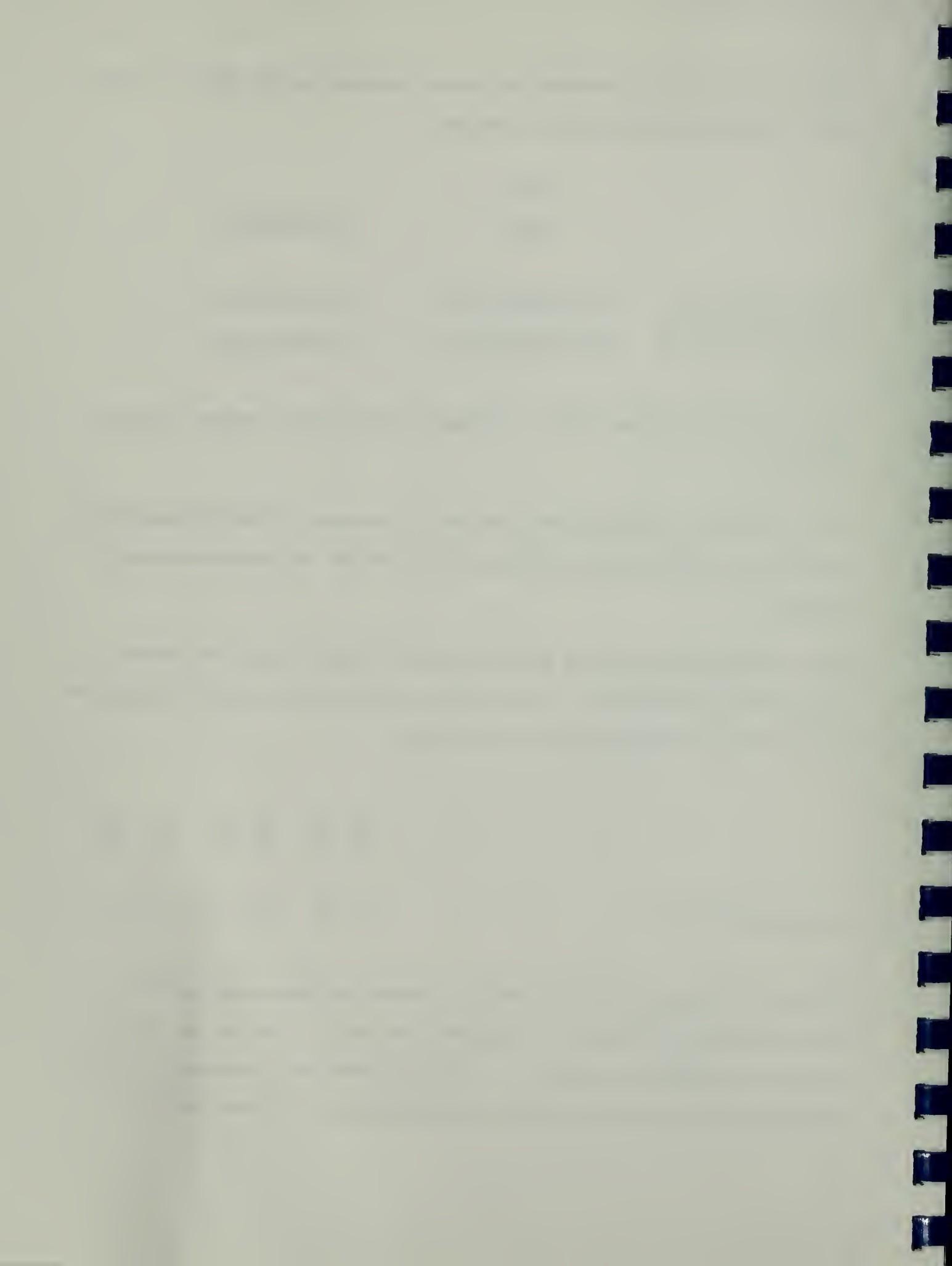
Other applicable charges, such as termination and one-time charges, are also the same.

It is concluded, therefore, that the cost relationship for the Billings-Miles City circuits would be nearly identical to those for the Missoula-Kalispell circuits.

The circuit requirements for this route are 10 voice and one data circuit. Using the 5% addition factor for overflow to discounted toll and increasing at 2% per year, the requirements are as follows:

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Billings-Miles City	12	12	13	13	14	14

The cost relationship indicate that T1 circuits are more economical than conventional circuits when the requirement reaches 17. An increase in the cost of conventional circuits or in the requirements or a requirement for 56 Kbps data circuits would warrant a re-examination of the route economics.



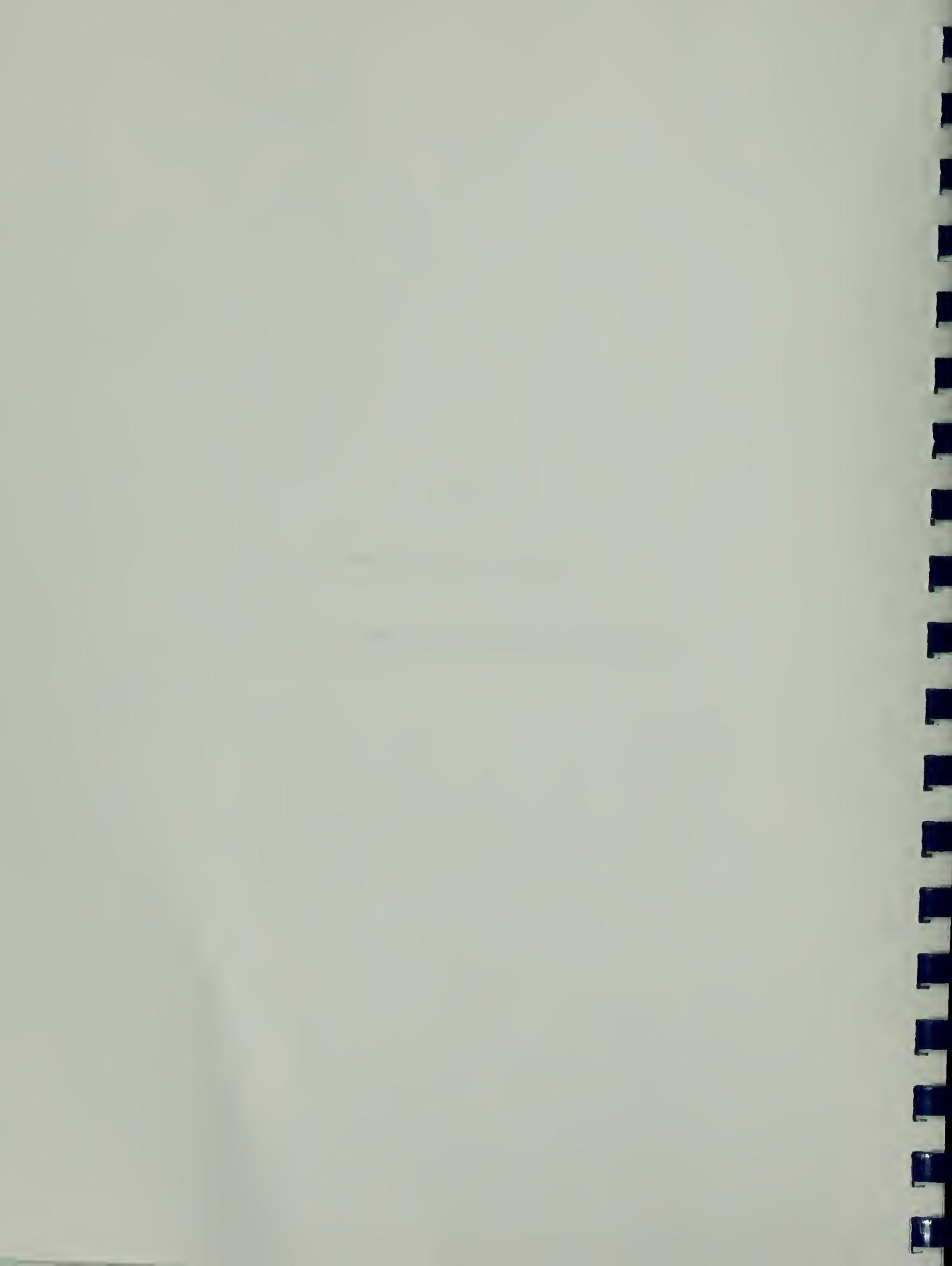




SECTION 9

SATELLITE/EARTH STATION

TELECOMMUNICATIONS SYSTEM STUDY, 5 CITIES



A budgetary proposal was requested for a satellite system to provide the telephone and data circuits between Helena, Billings, Bozeman, Great Falls, Missoula, Kalispell, Havre and Miles City. The costs received were incremental for earth stations on a per-site basis. Budgetary transponder rental costs were also included for estimating system costs.

The plan that is analyzed includes five earth stations and transponder capacity for the traffic generated by Helena, Billings, Bozeman, Great Falls, and Missoula. The results can be compared directly with the combined terrestrial plans for these cities.

The satellite system is not economically competitive with microwave radio or T1 for the applications studied. The satellite system is approximately 12% less expensive than conventional circuits for this application.

Television broadcasting capability could be added at a relatively small cost from one of the earth stations. If this should become a firm requirement at a future date, a satellite system should be re-examined for cost effectiveness at that time.

ECONOMIC SELECTION STUDY

DESCRIPTION:

Satellite Earth Station System, S.C., Inc.

PLAN — of — SWEET — or —
PREP. BY — M — DATE —
STUDY PERIOD — 86 - 95

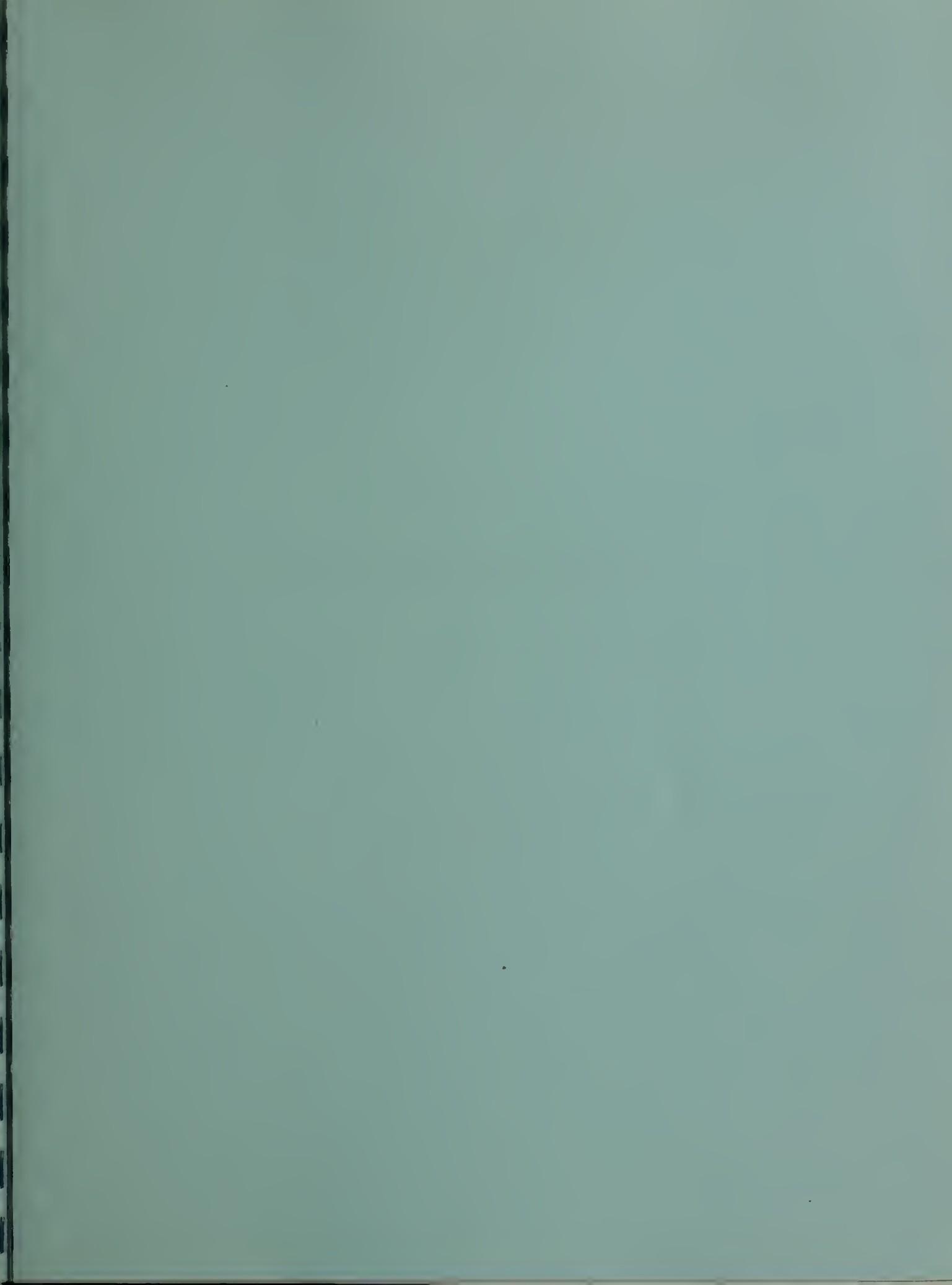
ITEM	CAPITAL REQUIREMENTS			REVENUE REQUIREMENTS			
	QUANTITY	UNIT COST	FIRST COST	PRESENT WORTH OF FIRST COST	ANNUAL COST	PRESENT WORTH OF ANNUAL COSTS	
	AMOUNT	DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	PERIOD FACTOR	AMOUNT
1 Reference Station	1	\$50,000	\$50,000	86			
2 Local Stations	4	\$25,000	2,080,000	86			
3 Frequency Coordination	140+	20,000	20,000	86			
4 and Licenses							
5 Shipping & go estimated	120+	10,500	10,500	86			
6 Site Work	4	5,000	20,000	86			
7 Total			2,680,500				
8							
9							
10							
11 Annual Transponder Cost	60500	X .79	X /2. 564				
12							
13 Total	1						
14							
15							
16							
17							
18							
19							
20							

REMARKS:

79 % of the circuits included in the proposal are served by the stations covered. The transmission cost was reduced accordingly.

Stations were included for direct comparison with the terrestrial plans.

TYPE OF PLANT	NON-STANDARD ANNUAL COST PERCENTAGES		
	(1)	(2)	(3)
TYPE M	Some 25 New Radios	(4)	(5)
PROPERTY TAX			
INCOME TAX			
DEPRECIATION			
MAINTENANCE			
TOTAL %			





SECTION 10

SMALL EARTH TERMINAL DATA SYSTEMS STUDY



A budgetary proposal was requested for a small earth terminal data system to serve the 56 county seats. Helena was assumed to be the location for the databases that would be accessed. Helena did not have an earth terminal, but entered the system via a leased telephone line to a master earth station, assumed for pricing purposes be located in California.

The analysis indicates that this is not a cost effective substitute for the existing data systems to the small cities. The monthly cost per terminal would be \$640, if purchased, or \$360, if rented. Additional services such as remote sensing, could be added at the same incremental cost if the system was in place.

If some of the emerging requirements for additional data services develop, this approach should be examined for cost effectiveness and survivability. Examples of new services that might become requirements in the future are access to brands registration information, access to library material, access to land title information, access to location files, transmitting engineering information between a remote construction site and a State headquarters or any low volume, wide-spread requirement for inquiry/response transaction networking.





SECTION 11

FIBER OPTIC ROUTE STUDY



A preliminary cost estimate of a fiber optic system with T1 channel banks was prepared for comparison with the costs of a microwave radio system in the same route. Helena-Bozeman was chosen for the estimate because it has the largest cross section circuit requirement, and therefore fiber optics were most likely to prove in.

The length of the route is approximately 95 miles. It was assumed that right-of-way would be available at no cost along State-owned or -controlled roads.

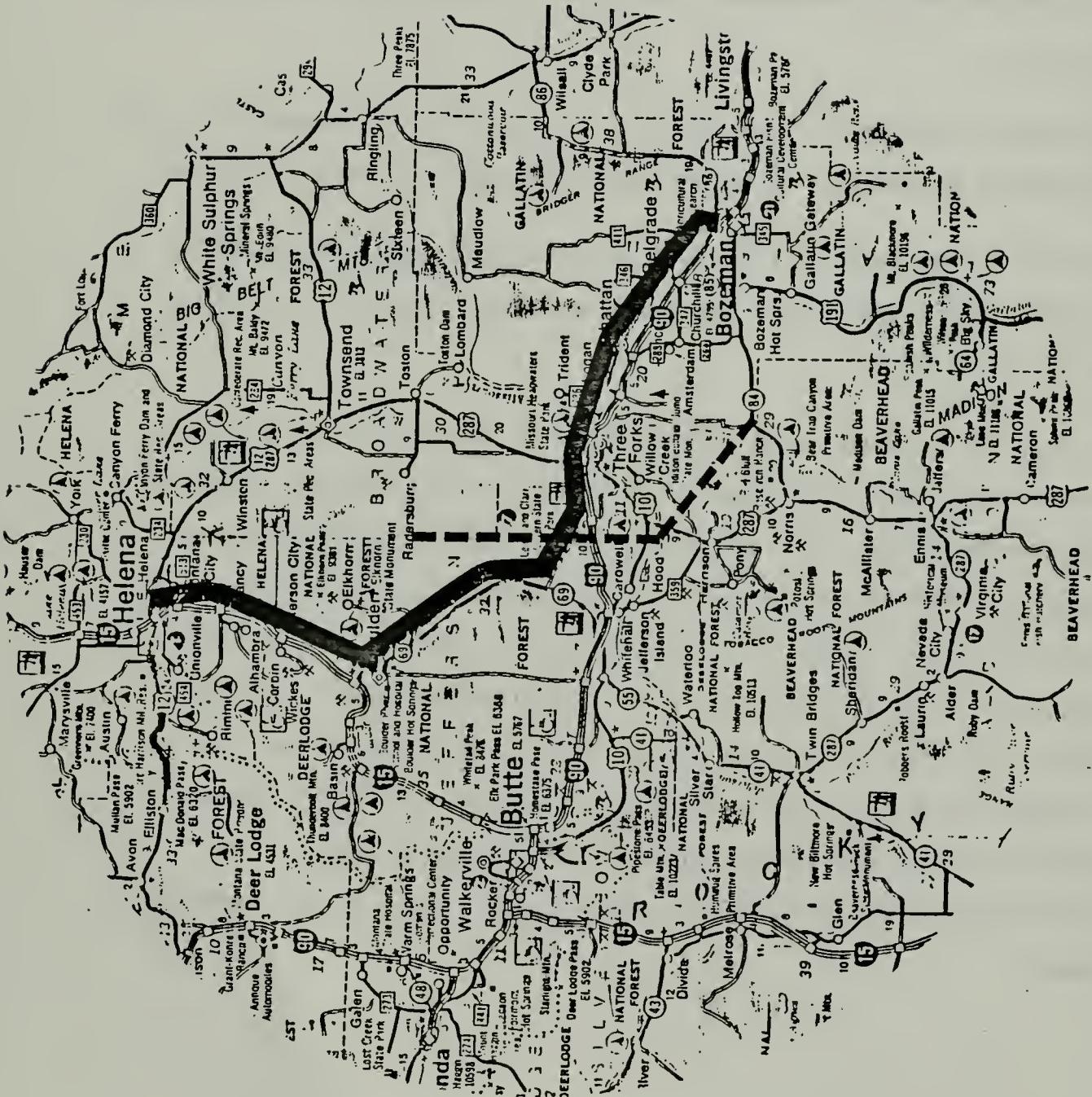
The total turnkey cost for this route is \$2,362,645. This compares with a microwave radio system of the same installed channel capacity, whose first cost is \$1,218,400.

The fiber optic system can be expanded to 15,000 voice circuits, while the microwave radio system described can be expanded to 192 channels. The fiber optic is cost effective for extremely large circuit requirements or, more accurately, bandwidth requirements, as it can support voice, data, television, or any application that can be converted to light pulses. In particular, the installed cost per circuit of the fully loaded microwave radio system would be \$6,346. The installed cost per circuit of the fiber optic system, when used to support 192 channels, would be \$13,727. However, when fully allocated, the fiber optic system would cost only \$157.50 per installed channel. The breakeven point between fiber optics and microwave occurs at approximately 372 channels.

HELENA-BOZEMAN FIBER OPTIC CABLE

FIBER OPTIC ROUTE

LATA BOUNDARY



MONTANA DIGITAL NETWORK
HELENA-BOZEMAN OPTICAL FIBER

ROUTE LENGTH	- 95 MILES - 152,888 METERS - 501,600 FEET	
6 OPTICAL FIBERS	- 3 PAIRS	
PRESENT MAXIMUM CAPACITY	- 1000 MBPS - 15,000 VOICE CIRCUITS	
		<u>COSTS</u>
RIGHT OF WAY		\$ NC
ROUTE ENGINEERING	- \$.18 x 501,600 FT	90,288
CABLE	- \$3.06/METER x 152,888 METERS	467,837
SPLICING AND SUPPLIES		292,600
CONSTRUCTION	- 501,600 FT x \$2.00/FT	1,003,200
OPTICAL SYSTEM	- 2 TERMINALS	75,000
MULDEMS		23,000
THROUGH REPEATERS	- 3	99,500
SUPPORT EQUIPMENT		50,000
OPTICAL SYSTEM	INSTALLATION AND TEST	64,000
CHANNEL BANKS	- 4 - 1.544 MbIT CAPACITY EACH	64,360
CHANNEL BANKS	INSTALLATION AND TEST	12,860
SUPPORT STRUCTURES		120,000
TOTAL		\$2,362,645







APPENDIX D

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APPENDIX E

GLOSSARY

GLOSSARY

A

A/D	Analog to Digital (conversion)
ADPCM	Adaptive Differential Pulse-Code Modulation
ATT COM	AT&T Communications, formerly Long Lines
ATT IS	AT&T Information Systems, a provider of customer premises equipment

B

BER	Bit Error Rate
Bit	Basic unit of digital information

C

CAD/CAM	Computer Aided Drafting/Computer Aided Mapping
CATV	Cable Television
C-Band	4/6 GHz Frequency Band used for Satellite Communications
CCR	Customer Controlled Reconfiguration
CO	Central Office - Switch Center
Channel Banks	Common equipment and individual channel electronic cards used to impress multiple circuit on a transmission facility. See Multiplex.
COAX	Coaxial Cable
CODEC	Coder/Decoder

Conventional Circuit Private line single voice or data circuit provided by a common carrier.

CPE Customer Premises Equipment

CSU Channel Service Unit

CVSD Continuously Variable Slope Delta Modulation

D

D/A Digital to Analog (conversion)

dB Decibel, unit of relative sound magnitude

DDD Direct Distance Dialing

DEMUX Demultiplexer

DSO Voice Channel or 56 kbps Data Channel

DS-1, DS-2, Frame and Signal Specification for Digital Transmission at
DS-3 & DS-4 1.544, 6.312, 44.736, and 274.176 Mbps, respectively

DSU Data Service Unit

DSX-1 T1 Channel Quality Specification; Pulse Template

DTE Data Terminal Equipment

DTS Digital Termination Service

DTMF Dual Tone Multi-frequency

D1, D1D, D2, Channel Banks for T1 Communications

D3 & D4

E

ESS Electronic Switching System

F

FAX Facsimile
FCC Federal Communications Commission
FDM Frequency Division Multiplex
F/O Fiber Optics, a transmission medium using light to transmit digital signals
FT2, FT3, Fiber Optic T-Channel Equivalent Systems
& FT4 (12.624, 44.736, and 274,176 Mbps)

G

G&A General and Administrative Expenses
Gbps Gigabits per second, bits X 10(9)
GHz Gigahertz, billions of cycles per second

H

HF High Frequency
Hz Hertz, formerly Cycles Per Second

I

ISDN Integrated Services Digital Network

K

Kbps Kilobits Per Second, 1000 bits/second
km Kilometer

Ku-Band 11/14 GHz Frequency Band used for Satellite communications
\$K Thousands of Dollars

L

LAN Local Area Network
LATA Local Access and Transport Area
LNA Low Noise Amplifier
LRCC Local Rate Center Connection
LSI Large Scale Integration

M

m Meter
Mbps Megabits per Second 1 million bit/second
Mhz Megahertz, millions of cycles per second
Microwave Radio A transmission system utilizing radios of 2 GHz and higher frequency to provide a carrier for communications circuits
MODEM Modulator/Demodulator
MUX Multiplexer. An electronic device for establishing structured divisions of a carrier facility so that multiple circuits can be carried simultaneously. May refer to multiple systems, rather than multiple individual circuits.
M24 AT&T Channel Banks - 24 Voice/Data Channels
M44 AT&T Channel Banks - 44 Voice Channels

N

N/A Not Available or Not Applicable

O

OCC Other Common Carrier

OCU Office Channel Unit

P

PBX, PBX Private (Automatic) Branch Exchange

PCM Pulse Code Modulation

R

RBOC Regional Bell Operating Company

ROW Right of Way

S

SCPC Single Channel Per Carrier

T

TDM Time Division Multiplex

TDMA Time Division Multiple Access

T1, T1C, North American STandard Digital Transmission Formats

T2, T3 & T4 (1.544, 3.152, 6.312, 44.736, and 274.176 Mbps)

U

UHF Ultra High Frequency

V

VF Voice Frequency

VHF Very High Frequency

